THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 51 JUNE, 1933 No. 2

TRICHOMANES

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SIXTY-ONE PLATES

Trichomanes, as a genus in modern technical descriptive botany, dates from Linnæus, Species Plantarum (1753) 1097. As shown by Underwood, Mem. Torrey Bot. Club 6 (1899) 256, its type is established by reference to earlier works of Linnæus, and is *T. crispum*, an American species belonging to an American group not represented in the Orient. The name goes back at least to Theophrastus and Dioscorides. An account of its history, with guesses at its etymology, is given in the Dissertation of Taschner, presented in Jena in 1843; but these matters do not concern us, because by pre-Linnæan authors, from the ancients to Tournefort, the name was applied to a wholly different fern, *Asplenium Trichomanes* Linn.

The usual, and one may say classic—since it has stood with most authors since the family was recognized—division of Hymenophyllaceæ is into the two genera *Trichomanes* and *Hymenophyllum*. Typically, *Trichomanes* has a tubular involucre and an elongate receptacle; *Hymenophyllum*, a two-valved involucre and included receptacle. Neither of these distinctions is constantly valid. The two genera, however, are phyletic entities, and in but few cases is there reasonable doubt as to the proper assignment of a species. I suspect that several species described as *Trichomanes*, which I have been unable to identify or place, are really *Hymenophyllum;* but the only ones objectively known to me as to which I am in any doubt are in Mettenius' group *Microtrichomanes*, included in this paper, but certainly related to other species universally regarded as *Hymenophyllum*.

Hymenophyllum and *Trichomanes* had doubtless a common ancestry; in other words, the family is a natural one. There

has been, then, in each genus, an element most related to the other; and this was the most primitive element of at least one genus, from which the others (if the genus is monophyletic) have been derived. If such primitive elements survive, they will be recognized. It they do not, it should be possible, with an attainable measure of understanding, to recognize the existing elements nearest to the more primitive extinct ones. This is, of course, the effort of every real student of the group, but I believe that none has yet succeeded; or at any rate, proven his case. Bower, Ferns 2: 248, the last to try, examining the most aberrant species which can be called *Trichomanes, T. reniforme,* and one *Hymenophyllum, H. dilatatum,* which he misconstrued incomprehensibly, and, electing them as primitive, naturally did not succeed. Many predecessors had made better use of better facilities, without settling the question; and I am one with them.

It is seductively easy to picture the evolution of the family as proceeding from the simplest form to the several groups of larger plants of more complex structure. Let *T. vitiense* be the most primitive, as it really is the simplest known in structure. *Microtrichomanes,* derived from it by the simplest dichotomy of the axes of growth, still without compounding of the frond, is the next step. *Hymenophyllum* proper, and *Leptocionium,* on the one hand, are easily pictured as evolutionary lines from this common source, without a visible break (if attention be held strictly enough to points of resemblance) as wide as we are used to jumping with complacency in all such series. In the other line (that is, *Trichomanes*), the dichotomous or flabellate architecture is maintained, with increasing size and the compounding of the frond, into *Gonocormus,* within which group the branching inevitable with greater size passes from dichotomous through irregular to pinnate. *Didymoglossum,* and thence *Taschneria,* may be derived from *Microtrichomanes;* and all other groups, from *Gonocormus.* I can present a more appealing argument for this scheme than has supported any previous picture of the internal phylogeny of the group; but I do not believe that it represents the facts of the case, even in a broad way.

In the first place, I am satisfied that the minute representatives of every group in which they appear are degenerate in size, not primitive. The smallest of them have undergone reduction until the mere loss of size inevitably involved the loss of characteristics of form and structure, leaving a common

residuum of basic form and structure which necessarily makes them similar, however distinct their ancestry may be. Let a *Trichomanes* or *Hymenophyllum* of almost any group suffer reduction to the stature of *T. vitiense,* and the resulting form must be very much the same; and the loss of structures which could not be supported by so small a frond, and of others which would at best be useless, will hardly fail to result in the structure of that species. The fact that the smallest members of many series are much alike is therefore no evidence that they are primitive.

On the other hand, the Hymenophyllaceæ are ferns, and leptosporangiate ferns, having beyond any question real affinity to other Leptosporangiatæ. It is not in reason to suppose that just those elements of the family—the most minute species, of simplest structure—which are least like other ferns, are the most primitive, by which I mean nearest to the ancestry in common with other ferns. Also, in general, the minute species are local, as compared with *Trichomanes* species in general. And in the cases in which this is not true of species and group—*T. muscoides,* in a broad sense, for instance—there are residual structures which bar any hypothesis of affinity to *Hymenophyllum. Microtrichomanes* and *Gonocormus* are of limited, even if broadly limited, distribution; and are most improbably ancestral to the cosmopolitan groups of *T. radicans* and *T. rigidum.*

In my tentative scheme of phylogeny, I construe as the most nearly primitive element of *Trichomanes* the *T. radicans-T. pyxidiferum* group, it being the least specialized, and therein the most similar to *Hymenophyllum.* So far I have convictions or ideas regarding the evolution, from something like this one, of the other groups of *Trichomanes,* these will appear in the course of this treatise, as the characterization of the several groups introduces the appropriate evidence.

There has been the utmost diversity in the position assigned to the family as a whole. Some writers, guided by the simplicity of vegetative structure, have placed it at the bottom of the fern series. Others have assigned these ferns a place near *Davallia,* within the Polypodiaceæ. It is now accepted as a fact that these ferns are Leptosporangiatæ, and generally agreed that within this group they represent an evolutionary line farther advanced than Osmundaceæ, but not so far as Polypodiaceæ, perhaps on a level with Schizaeaceæ and Gleicheniaceæ. As compared with these, however, this family is rich in species, which is evidence of recent evolutionary activity.

Osmundaceæ, Gleicheniaceæ, and Schizaeaceæ (except *Anemia*) are groups with few species of very wide geographical range; which is evidence of considerable geologic age. In the course of this study I have become convinced that *Trichomanes* exhibits the same phenomenon, in a measure not appreciated, and not evident since the general revulsion from the comprehensive species-concept of Hooker and Baker. In these days, a work of this kind results almost always in a considerable increase in the number of species for which recognition is claimed. Christensen's treatise on the American species of *Dryopteris* and my own on *Plagiogyria* and *Calymmodon* are in harmony with the trend of the time. It is not unusual for a monograph to double the number of species in a genus, nor unheard of for it to multiply the number by ten. I describe new species in this treatise, as they are presented by a wealth of material such as nobody has had in hand before; but I leave the genus smaller in number of recognized species than I found it. It is a large and diversified genus, but it contains a considerable number of species which compare in range with the species of *Gleichenia* and *Lygodium*. It is an old genus, as they are old.

The chief explanation of the shrinkage in species has not been the careless redescription of identical plants by my predecessors—which has naturally occurred here, as in other genera. In greater number, species are reduced to synonymy because I have found the species of *Trichomanes* to be plastic, in a measure unknown to me in any other group. Recognizing this condition, I have then recognized the identity in many cases of plants so distinct in appearance that reasonably good descriptions, as such things go, have shown no reason to suspect the identity.

This plasticity or polymorphism is most remarkable in *Gonocormus*, but, less conspicuously, characterizes *Trichomanes* as a whole. Its commonest expression is extreme variability in the size of fertile fronds. It is my impression that among ferns and vascular plants in general, a range in lineal dimensions from 1 to 2 more than suffices to cover any normal or at all common variation in size; that is, if the common limit in length of frond is 20 centimeters, few if any will be found fertile less than 10 centimeters long. A wider range is common in *Trichomanes*, even 1 to 4. Correlated with the variation in size, there must be some, and may be other, modifications. Dwarfs in the group of *T. rigidum* tend to be relatively narrow; in the group of *T. radicans*, relatively broad. A species may be quadripinnatifid in full development, but only bipinnatifid in its dwarf forms.

The segments or pinnules of a dwarf may be narrower, but are surer to be less numerous, than on an ample specimen. Meric distinctions have perhaps had undue prominence in recent descriptive botany; but even when they were formally barred from diagnoses, and presented in supplementary comments if at all, they found expression in other terms. Thus, with the loss in number of coördinate segments a pinnatifid pinnule which is linear with 11 of them becomes ovate if the number falls to 5; trifid, palmate or flabelliform if it falls to 3; furcate or auriculate if it loses another; and simple, with reduction to one. Such differences as these terms denote characterize species in general, in all groups; but a considerable number of invalid *Trichomanes* species owe their publication to failure to recognize these differences as necessary incidents to decrease in stature.

Assign any plant to the wrong genus, and it makes a very distinct new species. The most important part of every description of a species is condensed in the generic name. The description may be accurate and as complete as ought to be necessary, but if the generic name is wrong the plant is likely to be unrecognizable. In *Trichomanes*, assignment to a subgenus or group, or comparison with some species typifying a group, has often been used in substitution for many words of description—and to good purpose, if the assignment was correct; but some authors have had amazingly little understanding of the groups, and even the lysigenists have known them imperfectly. In most of the instances in which I have failed to place a species, it is because the group is not stated, or because I mistrust the statement. In more instances, the examination of authentic specimens has enabled me to locate species which otherwise would have remained pure mysteries.

From 1843, at the latest, when Presl's Hymenophyllaceae appeared and the first volume of Hooker's Species Filicum, including these plants, was prepared, it should have been clear that particular care was demanded in descriptions of these plants; yet no subsequent descriptive botanist has seemed to be guided by this fact, with the single exception of van den Bosch. In particular, the work of Presl and van den Bosch left no chance for reasonable doubt as to the importance of the venation, for the recognition of species and groups, yet this criterion is totally ignored in a large part of the descriptions published since their times.

I have written many treatises on genera of ferns, but have found no other comparable in difficulty with *Trichomanes*. The difficulties which have just been rehearsed—careless, incomplete,

and wrong descriptions—more serious in this than in most genera, and strongly discrepant and discordant treatment by previous specialists in the group, were not the most fundamental trouble. My first attempt at a presentation of the Malay-Asiatic species dates back to 1908. Several years of intermittent effort brought me to the conclusion that no digest and summarization of the literature, such as had served some purpose in my hands with the equally large genus *Cyathea*, and was proving very useful as performed by van Alderwerelt for the ferns as a whole of that region, would have any utility at all in the case of *Trichomanes*. The early difficulty seemed to be that I did not have authentic material of enough species, and could not recognize or conceive them with a measure of objective reality, by description. With some special effort, I accumulated specimens from year to year, trying several times, in vain, to block the work out in a manner to promise eventual success. Not until after twenty years did it become plain that my real, basic difficulty, and that responsible for the measure of failure of my predecessors, was failure to recognize the groups.

Such satisfaction as I take in the presentation of this treatise is based, not on the description of some species as new, and on the reduction to synonymy of a more considerable number, including a fair part of those for which I was previously responsible, but on the feeling that the groups are now correctly segregated, and the hope that, by word and illustration, they are made recognizable by others.

As to the status of these groups, I adopt for the present a conservative attitude, and avoid the occasion of publishing any new names for old species by letting *Trichomanes* remain a very large and diversified genus. Only the most unique species, *Cardiomanes reniforme*, is given separate generic status. Many of the groups are entities as distinct as are many of the genera recognized in Polypodiaceæ; and the maintenance of such a genus as *Trichomanes* does not serve convenience. It should and, eventually or presently, will be broken up. This need not be done in haste, and before I take the step there are several questions to be answered; for instance, what should be included in *Didymoglossum*. Most, perhaps all, of the groups worthy of generic rank have names—some generic, some that can be made generic. *Crepidium* may be the only one usable for a group without formal status but not available for a genus.

My need of twenty-four years for this work will be understood, and the imperfections still manifest and sure to become so will be more readily excused, after a cursory review of the

previous efforts. Monographic treatises on Hymenophyllaceæ have been undertaken by Presl, Hooker (in Species Filicum), van den Bosch, Mettenius, Prantl, and Giesenhagen. Only the first two have, even in form, accomplished their purpose.

Presl, Hymenophyllaceæ (1843), divided the genus, as previously construed by most writers, into two sections, each consisting of a number of genera. Among these genera as represented in our area, only *Cardiomanes* retains that rank in the present treatise. *Cephalomanes, Microgonium* (including *Hemiphlebium*), and *Abrodictyon* are groups susceptible of generic recognition; but his *Didymoglossum* is not so, whatever may be true of the original *Didymoglossum* of Desvaux. In Epimeliae Botanicae (1849), Presl first (pp. 16–21) increased the number of sections left in *Trichomanes;* and then (p. 258) raised *Crepidomanes* and *Pleuromanes* to generic rank with diagnoses, and published without diagnoses *Crepidium, Taschneria, Leucomanes,* and *Amphipterum,* illustrating each by a species. This would be sufficient evidence that Presl was not finished with his treatment of the groups; if not, it may be noted that his *Pleuromanes pallidum* and *Leucomanes album* are one species. As to the species, Presl avowed his work as not near completion.

Hooker paid his compliments to Presl's treatment in such comments as "Than which nothing can be more at variance with nature." But he fared no better himself; for Kuntze, in a review running through many numbers of the Botanische Zeitung (1847), subjected his treatment, species by species, to a criticism so competent that we must regret that he, instead of Presl and Hooker, did not undertake a systematic presentation of the genus.

Van den Bosch, a physician by profession, presented the Hymenophyllacae Javanicae (1861), carefully described and beautifully illustrated. Fascinated by these plants, he took up the task of monographing the order, and as a preliminary published a Synopsis (1859), listing and arranging the species known to him. In 1861 and 1863, he published as supplements to the Synopsis numerous new species, which were based in large part on specimens in the Hooker herbarium, and which Hooker, Synopsis Filicum (1867), promptly refused to recognize. In all of these works there was a rough approximation to Presl's classification; but at the same time he published an outline[1] of his own proposed classification of the order. As this remains even

[1] Eerste Bijdrage tot de Kennis der Hymenophyllaceae, Versl. in Meded. d. Koninkl. Akad. van Wetenschappen. Afb. Natuurk. 11 (1861) 300–330.

to-day the most competently prepared complete outline, it is here reproduced, in full as to the subjects of my own study and in outline as to other subjects.

Suborder 1. HYMENOPHYLLACEAE. Lamina 1 cell thick.
Tribe 1. HYMENOPHYLLEAE. Two genera.
Tribe 2. LEPTOCIONIEAE. Three genera.
Tribe 3. TRICHOMANEAE. Indusium tubular.
A. Lip of indusium bilabiate.
Hemiphlebium Presl.
Didymoglossum Desv.
B. Lip of indusium undivided.
a. False veinlets present.
Microgonium Presl.
Crepidomanes Presl.
Lacostea v. d. Bosch.
b. False veinlets wanting.
Venation catadromic. Four American genera.
Venation anadromic.
Cephalomanes Presl.
Phlebiophyllum v. d. Bosch.
Habrodictyon Presl.
Gonocormus v. d. Bosch.
Trichomanes Linn.
Suborder 2. DIPLOOPHYLLACEAE.
Cardiomanes Presl.
Craspedoneuron v. d. Bosch.
Three American genera.
Suborder 3. LOXSOMACEAE.
Loxsoma.

It may be noted here that the genera of his predecessors were handled very freely by van den Bosch. *Didymoglossum* of Desvaux, for example, would have included *Hemiphlebium*, but the *Didymoglossum* of van den Bosch is substantially Presl's *Taschneria*. *Crepidomanes* of van den Bosch includes and is typified by *Crepidium* of Presl. *Craspedoneuron* is Presl's *Pleuromanes* and *Leucomanes*.

At this point, death denied Doctor van den Bosch the opportunity to complete his study. A half-century later, some of his notes were published.[2] Mettenius,[3] Prantl,[4] and Giesenhagen,[5] all avowedly undertook to monograph the family, and all began with an anatomical study, yielding information wanted for the

[2] Meded. van s'Rijks Herbarium No. 17 (1913); No. 38 (1919).
[3] Ueber die Hymenophyllaceae. Abhandl. Sächs. Ges. Wiss. 7 (1865) 401–504; 5 plates.
[4] Die Hymenophyllaceen (1875).
[5] Die Hymenophyllaceen. Flora 73 (1890) 411.

eventual classification of the plants. Only Prantl reached the point of presenting the outline of a scheme of classification, and he did not carry this beyond the use of a fraction of the known species, to illustrate his genera and sections. In outline, including the most of the Oriental species listed, Prantl's classification, Die Hymenophyllaceen (1875) 45–53, is as follows:

Tribus I. TRICHOMANOIDEAE.

Fam. 1. CARDIOMANEAE.

1. *Cardiomanes: C. reniforme* (Forst.) Presl.

Fam. 2. PTILOPHYLLEAE.

2. *Hemiphlebium* Presl emend.

Sect. 1. *Microgonium: H. sublimbatum, Motleyi* and *cuspidatum* (& American).

Sect. 2. *Hemiphlebium* Presl em. VDB. all American.

Sect. 3. *Lecanium* Presl, VDB.: *H. membranaceum*, American.

3. *Ptilophyllum* VDB. emend. all American.

4. *Lacostea* VDB. em.

Sect. 1. *Lacostea* VDB. em. American.

Sect. 2. *Cephalomanes* [as I construe it].

Fam. 3. TRICHOMANEAE.

5. *Gonocormus* VDB. em.

Sect. 1. *Gonocormus* VDB. 4 spp. Javanicae.

Sect. 2. *Microtrichomanes* Mett. 5 spp. orientales.

6. *Trichomanes* L. em.

A. Minora.

Sect. 1. *Crepidomanes* Presl em.: *T. humile, schmidianum, intramarginale*, & 2 American.

Sect. 2. *Didymoglossum* Presl em.: *T. Filicula, capillatum, bilabiatum.*

Sect. 3. *Craspedoneuron* VDB.: *T. album, pallidum, Braunii, glaucofuscum.*

Sect. 4. *Phlebiophyllum: T. venosum.*

B. Majora.

Sect. 5. *Leptomanes:* Amer. exc. *T. Smithii* (*Abrodictyum Cumingii* Presl).

Sect. 6. *Eutrichomanes: T. speciosum, maximum, longisetum, apiifolium*, & American.

Sect. 7. *Lacosteopsis:* Amer. incl. *T. radicans.*

Sect. 8. *Selenodesmium: T. rigidum, obscurum, elongatum.*

Sect. 9. *Davalliopsis:* American.

TRIBUS II. HYMENOPHYLLOIDEAE.

7. *Hymenophyllum,* in 4 sections.

Even more than van den Bosch, Prantl changed the use of the older generic names.

There have been two more-recent enumerations of the species. Sadebeck [6] began, like Prantl, with the species with simple fronds, but did not apparently attempt to classify the species for any other purpose than facility of identification. The same is true of the Malayan Ferns of van Alderwerelt van Rosenburg. In both of these works, the minor genera of Presl, van den Bosch, etc., are abandoned or reduced to the status of sections. At least for the present this is my policy also.

While intending this treatise to serve as a monograph for the group and region treated, I have fallen particularly far short of the mark as to the western part of the area—Africa and its islands. I would have preferred to restrict myself to the Malay-Asiatic floristic region, but was forced to take account of the African islands, because some of the species most critically important in the Malay region were described there. Being thus compelled to deal with these species and islands, I have thought it expedient to treat the African species, so far as material was available. However, my presentation of the African species has had to remain so incomplete that I have abstained from even the mention of species not seen—except and unless these species have at some time been reported farther East.

I have deliberately deviated from modern monographic practice—a practice for which the model was established for all time by Milde's treatise on *Equisetum*—by abstaining from the citation of literature and of collections, except as the citation could be expected to be of service to some other worker. The listing, as citations of literature, of every published mention of a species or of its name has become a silly waste of space. As exemplified in many recent treatises, the lists of publications have no necessary relation to the plant, but only to its name; and the compilers of such lists usually have and can have no idea as to whether the plant or merely its name is referred to. I would have added not less than one-third to the bulk of this publication by complete citations of this kind. Brause lists, for example, fifty-one species of *Trichomanes* from Papua. The mere citations, one at a time, would occupy perhaps a page. In a case like *T. acroscopum*, the citation would serve no purpose because he merely refers to another publication; in such cases, though, one is at least sure of the plant in question. In a case like *T. bipunctatum*, even that much is not certain; I

[6] Natürlichen Pflanzenfamilien of Engler and Prantl 1 pt. 4 (1902).

doubt its occurrence in Papua, but may not presume to correct Brause's list without seeing all the specimens on which it was based—an impossibility which is patent when it is considered that the list is partly original and partly founded in turn on mere report.

Even in devoting space to the listing of synonyms I have been abstemious—possibly too much so in this case. Pteridologists have in Christensen's Index Filicum the most perfect compilation of synonyms ever compiled for any large group of plants, and make poor use of it if it is used to facilitate instead of to obviate the padding of our literature with lists of this kind.

I have listed collections only when there was an evident service to be performed by the citation—types, of course; other specimens authenticated by the author or by comparison with the type; specimens peculiar enough to require detailed mention; specimens substantiating statements as to range, when this seemed necessary; specimens distributed wrongly named; some doubtful cases; and the subjects of my illustrations, to permit appraisal of their authenticity. The enumeration under each common species of every collection seen, and of the herbaria in which it is represented, impresses me as a waste of space. It has been incumbent upon me to examine several hundred specimens of some of these species, which is bad enough without the publication of the details. The time approaches when such enumeration will be impossible; as herbaria multiply and grow, the subject of a volume would have to be one species, instead of a genus or family.

An index of collections, arranged by collectors and their collection numbers, in sharp contrast with an enumeration of collections arranged by species, would be of real utility in the application of names to herbarium specimens, and the impossibility of compiling such an index is regretted.

The distribution of the species of *Trichomanes* is remarkably uniform. Statistics as to the number of species in different geographical regions are, of course, subject to distortion incidental to the selection of the areas and the interpretation of the species. Construing the species as I have done, and dealing only with those which I list with numbers, Polynesia (including Hawaii but not New Zealand nor New Caledonia) has 30; Asia excluding the Malay Peninsula, 20; Papua, 27; the Philippines, 27; Java, 24. Africa, including its islands, would fall within this range if I had been able to treat it with the same thoroughness. These figures illustrate the subjective nature of

such statements, being too low for Asia, because of my summary treatment of *Taschneria,* and too high for Java, because of maintenance of disproportionally many species of *Gonocormus.* Still, whatever allowance may be made for my inconsistencies and mistakes, it remains true that the distribution is strikingly uniform.

The wide distribution of the most of the groups is also noteworthy. Only two of the groups—and these the only monotypic groups, *Abrodictyum* in the Philippines, and *Phlebiophyllum* in New Zealand—are local. *Crepidium* and *Pleuromanes* range from Asia across Polynesia. *Microtrichomanes, Gonocormus, Taschneria, Macroglena,* and *Cephalomanes* range from Polynesia west at least to the East African Islands. The groups of *T. pyxidiferum, T. radicans,* and *T. rigidum,* and *Hemiphlebium* are pantropic or world-wide.

Beside the facilities of the University of California and of my own herbarium, I have had loaned for a long period the specimens subject of this study from the United States National Herbarium, the Gray Herbarium, and the herbaria of the Bureau of Science in Manila, the Singapore Botanic Garden, and the California Academy of Science. After the University of California contributed more than 800 dollars to the illustration of this study, the National Research Council made possible its completion by a grant of 500 dollars. To all of these institutions and to their chiefs and to those inconvenienced by my calls and my delays, I tender this expression of very sincere gratitude. To Dr. W. R. Maxon, Dr. E. D. Merrill, Dr. Carl Christensen, Dr. H. L. Lyon, and Count Ugolino Martelli, I am indebted for assistance in details.

All photographs have been made by Mr. W. C. Matthews, whose work speaks competently for itself. The drawing was done at first by Miss Alice Hamilton; the illustrations of *T. dentatum* and *T. caudatum* are examples of her work. Miss Phyllis Wrightson then assisted me for nearly a year, and is entitled to the largest part of the credit for the artistic quality of the drawings. This phase of the work was completed by Dr. H. S. Yates, to whom I am indebted for much technical judgment as well as for quickness and accuracy. Plate 1, fig. 2, is the work of W. Garcia. Good illustration is of such exceptional importance in a treatise on *Trichomanes* that the obligation to the artists deserves particular emphasis. For the composition of the most of the plates, I am indebted to the Bureau of Science and, particularly, to Dr. Eduardo Quisumbing.

Finally, being called away for work of another kind as this study approaches completion, I entrust the final details of preparation for the press to Dr. H. F. Copeland, in charge ad interim of the herbarium of the University of California.

List of the groups.

1. Pyxidifera.
2. Phlebiophyllum.
3. Pleuromanes.
4. Gonocormus.
5. Microtrichomanes.
6. Crepidium.
7. Taschneria.
8. Hemiphlebium.
9. Scandentia.
10. Grandia.
11. Apiifolia.
12. Rigida.
13. Cephalomanes.
14. Abrodictyum.
15. Macroglena.

Key to the groups.

Rhizome creeping, filiform.
- Fronds simple or lobed ..... 8. *Hemiphlebium.*
- Fronds dichotomous or palmate, never proliferous. 5. *Microtrichomanes.*
- Fronds dichotomous to pinnate in plan, some axes proliferous. 4. *Gonocormus.*
- Fronds pinnate in plan, not proliferous.
  - Without false veins or specialized margin.
    - Segments with costa only ..... 1. *Pyxidifera.*
    - Not dissected into segments with single veins. 2. *Phlebiophyllum.*
  - Margins specialized, without other false veinlets.
    - Broad, thick axial pads present ..... 3. *Pleuromanes.*
    - Without broad axial pads ..... 6. *Crepidium.*
  - Spurious veinlets present ..... 7. *Taschneria.*

Rhizome stout and/or fronds clustered.
- Fronds simply pinnate, stipes clustered ..... 13. *Cephalomanes.*
- Fronds more compound, or stipes remote.
  - Fronds dissected into almost bristlelike segments. 15. *Macroglena.*
  - Segments broader, or soft.
    - Rhizome elongate, fronds remote ..... 9. *Scandentia.*
    - Rhizome shorter, erect, fronds clustered.
      - Cell walls not thickened and pitted.
        - Epiphytes with large, tender fronds ..... 11. *Apiifolia.*
        - Terrestrial, with firm fronds ..... 10. *Grandia.*
      - Cell walls thickened and pitted.
        - Cells elongate transversely to costa .. 14. *Abrodictyum.*
        - Cells not elongate transversely to costa ....12. *Rigida.*

I. THE GROUP OF TRICHOMANES PYXIDIFERUM

Small ferns, with creeping, filiform rhizomes, pinnatifid or more compound fronds, and no false veins or specialized margins. The species assembled here are not altogether a natural

group. The most of them, with the group of *T. radicans*, really constitute one group, which is the least-specialized element of the genus, and on this ground susceptible of construction as its most primitive element. From the group here treated, taking it in a generalized sense, have probably been derived *Crepidium*, *Gonocormus*, *Pleuromanes*, *Phlebiophyllum*, and *Taschneria*. Tropics of both hemispheres.

Key to the species.

Involucre not bilabiate, or but slightly so.
  Rachis winged.
    Sori axillary.
      Involucre narrowly winged.
        Mouth entire.
          Frond commonly 5 cm long..... 1. *T. pyxidiferum.*
          Frond less than 3 cm long..... 3. *T. parvum.*
        Mouth dentate ..... 4. *T. draytonianum.*
      Involucre broadly winged.
        Frond lanceolate to oblong..... 9. *T. latifrons.*
        Frond commonly ovate..... 5. *T. schmidianum.*
    Sori terminal on major segments..... 2. *T. stenosiphon.*
  Rachis wingless ..... 7. *T. Colensoi.*
Involucre strongly bilabiate ..... 6. *T. Hosei.*

1. TRICHOMANES PYXIDIFERUM Linnæus. Plate 1, fig. 1.

Trichomanes pyxidiferum LINNÆUS, Sp. Pl. (1753) 1098.

Trichomanes frondibus sub-bipinnatis; pinnis alternis confertis lobatis linearibus.

Filix pyxidifera *Plum. fil. 74. t. 50. t. B.*

* * * * * * *

Habitat in America.—Linnæus, loc. cit.

Rhizome creeping, filiform, densely beset with black hairs; stipes remote, 2 to 3 cm long, terete, with a narrow wing on the upper part; frond up to 8 cm long and 3.5 cm wide, 5 by 2 cm being a commoner size, bi-tripinnatifid; rachis winged; segments less than 1 mm wide, short, green; marginal walls thin, lateral walls moderately thick but appearing more so because of the contents appressed to them, straight, uniform; sori occupying short lower segments, involucre 2 mm long, winged, with dilated mouth, not or hardly bilabiate, receptacle protruding by twice the length of the involucre. The sorus illustrated, Plate 1, fig. 1, is atypical, having the tube wider, and the mouth less dilated than usual.

Natal, *Wood, s. n.* Kilimanjaro, *Daubenberger 32.* Usambara, *Holst 1243.* Also in the American Tropics.

Fehse 15, from Kamerun, has sori occupying all segments near the apex of the frond. *Last 349,* from eastern tropical Africa, has the mouth more overfull, and therewith somewhat bilabiate. A Natal specimen, *Buchanan 1, U. S. Nat. Herb. 827161,* has the involucre very narrowly winged, rather short, and truncate. All of these can be *T. pyxidiferum,* without removing all bounds to the species. *Staudt 454,* distributed as *T. erosum,* which it is not, may also be a small form of it, and is at any rate a relative.

On the other hand, no one of the very many Asiatic and Malayan specimens found bearing this name may well be so construed. In about equal numbers, the most of them are either *Gonocormus,* or relatives of *T. bipunctatum,* with false veins.

Trichomanes pyxidiferum and *T. radicans* are related, and no wide gap separates the smaller plants referred to the latter species from strong specimens of *T. pyxidiferum. Trichomanes pyxidiferum* as a group, not in this connection as a species, is reasonably to be construed as parental to *Pleuromanes,* to *Gonocormus,* and to *Crepidium;* and I believe that the same ancestry may reasonably be postulated for *Taschneria.*

2. TRICHOMANES STENOSIPHON Christ. **Plate 1, fig. 2.**

Trichomanes stenosiphon CHRIST, Fedde's Repert. 5 (1908) 10.

Rhizomate tenui, intricato, longe repente, more *Hymenophyllorum* intertexto, ramosissimo, radicoso. Foliis numerosis approximatis, stipite 1 ad 3 cm longo alato, fronde 3 ad 5 cm longa, ovata acuminata aut rotundata, ad basin haud attenuata, tripinnatifida, rachiolata [rhachi alata] undulata, pinnis alternis patentibus, confertis, ovatis, infimis deltoideis, costis costulisque alatis, pinnulis ovato-cuneatis, iterum fere flabellatim dissectis, lobis ultimis 1 mm latis, furcatis, subacutis, saepe valde divaricatis, nervo uno conspicuo praeditis, urceolis terminalibus 1½ mm longis, ¾ mm latis, cylindricis, raro subcampanulatis, vix aut ne vix quidem latioribus quam lobi soriferi; ore vix dilatato, receptaculo exserto, textura subcoriacea diaphana; colore atrobrunneo.

Corea: in lacunis torrentium, Quelpaert, Oct. 1906, No. 108 (Urb. Faurie leg.).—Christ, loc. cit.

My specimen of *Faurie 108* is almost sterile, but *106* of the same collection is the same species and fits the description completely. *Faurie 124* of 1906 and *56* of 1907 are probably not specifically different, but have broader indusia, those of *124* more evidently bilabiate.

The crisping of the wing of the rachis, in a manner suggesting *Hymenophyllum australe,* is very evident on *Faurie 106,*

108, and *56*. The position of the sori, immersed in the apices of the major segments, is notable in the group; and the involucres, especially those of *106*, when observed dry, well justify the specific name.

Known from Korea only. Like *T. parvum*, a reduced member of the group of *T. radicans*. I do not know that it is not *T. amabile* Nakai, which, by description, I have reduced to *T. radicans*.

3. TRICHOMANES PARVUM Copeland sp. nov. Plate 1, fig. 3.

T. parvum gregis T. radicantis, rhizomate filiforme nigrohirsuto; stipitibus setiformibus 1 ad 2 mm longis deinde 1 cm longis ad latitudinem 1 ad 1.5 mm alatis; fronde 2.5 ad 3 cm alta, 1.5 cm lata, bipinnatifida segmentis interdum apice fissis, rhachi late alata; pinnis (accuratius segmentis primae ordinis) paucis, late ovatis, flabellatim pinnatifidis; parietibus cellularum tenuibus, ob interanea aspectu crassioribus; venis spuriis omnino carentibus; soris axialibus acroscopicis, sessilibus, parvis, involucro vix ultra 1 mm longo, infundifuliforme, alato, ore leviter dilatato non bilabiato, receptaculo exserto.

Formosa, Tamsui Mountains, "damp rocks in dark glens—very rare." *W. Hancock 107*, September 4, 1881. Type, *U. S. Nat. Herb. 51140*. Only one of the many fronds of this specimen is fertile.

As occurs with other small species, the imperfectly or atypically developed fronds are of all possible shapes. The winged stipes mark this dwarf clearly as no *Gonocormus;* these, with the black, densely hairy rhizomes, the texture, and the sori, let it be recognized as a relative of *T. radicans*, the most reduced known. It cannot be identified with *T. Kurzii* (assuming identity with *T. nanum* van den Bosch), nor with *T. acuto-obtusum* Hayata, because of the absence of false veins. It is distinguished from its relative, *T. stenosiphon*, by the position of the sori, the broad wing on the stipe, and the noncrisped wing of the rachis; as the two are known, it is distinctly smaller.

4. TRICHOMANES DRAYTONIANUM Brackenridge. Plate 1, figs. 4 to 7.

Trichomanes draytonianum BRACKENRIDGE, U. S. Expl. Exped. 16 (1854) 252, pl. 36, fig. 3.

HAB. Sandwich Islands; in humid forests, creeping over the trunks of trees.

Rootstock creeping and *pubescent*, stout in proportion to the size of the fronds; the rootlets *tomentose* with a dense coating of short black hairs. *Stipe flattened*, about half an inch in length, smooth, with a narrow mar-

gin, which increases in breadth towards the base of the frond. *Fronds broad-lanceolate,* glabrous, 2 inches and upwards in length, by 8 to 10 lines broad, of a pale green colour, deeply *bipinnatifid* at the base; the *primary divisions* somewhat rhombic-*ovate* and less deeply divided: *laciniae short, nearly oblong, obtuse, simple,* or else *bifid* or bidentate. Rhachis and veins stout of a dull-brown colour. *Indusium supra-axillary, subcylindrical, immersed, about half its length, attenuated at the base, the mouth spreading, scarcely two-lipped,* its diameter nearly equal to the length; the wings on the outer side sometimes wanting. *Receptacle filiform, exserted* about twice the length of the indusium.

Related to the preceding species [*T. humile*]; but readily distinguished by its only partially immersed indusium, with a more spreading mouth, and by the absence of a thickened margin to the frond.

Brackenridge's descriptions of new species are provided with brief Latin diagnoses, but the English versions are the more authoritative as well as the more complete.

Brackenridge collected this species on Oahu and Hawaii; I have it also from Kauai, Molokai, and Maui. It has been distributed under its proper name, as *T. humile,* and as *T. Filicula.* To the last (*T. bipunctatum*), it has no near affinity. There is more resemblance to *T. humile.* If this is evidence of affinity, *T. draytonianum,* confined as it is to the Hawaiian Archipelago, which has certainly derived the greater part of its fern flora from the South Seas, is to be regarded as a derivative of *Crepidium,* which has lost the distinctive character of that group of species.

Aside from the absence of the specialized margin, it is distinguished by a more-expanded lip, with shallowly sinuate-dentate margin; by less-dissected primary segments (pinnæ), giving the frond a more compact appearance; by the occasional absence of a wing near the base of larger fronds, which are then really pinnate; and by the presence on such fronds of two or three sori on the larger primary segments. I do not find on Brackenridge's material, nor on any other, any sori which are not winged throughout; the wing is very variable, sometimes wider than I have ever seen in *T. humile.* The mouth is not bilabiate, but is so dilated that it is almost always made to appear so when pressed.

5. TRICHOMANES SCHMIDIANUM Zenker. Plate 2, fig. 1.

T. Schmidianum ZENKER ex Taschner, Dissert. (1843) 34, pl. 1, figs. 1, 3, 5.

Tr. fronde bipinnatifida, ovato-oblonga; rhachi alato sinubus subrotundis; lobis oblongis obtusis, pinnatifidis, decurrentibus; laciniis bi-trifidis subretusis, margine integro, nervis stipiteque squamoso-hirsutulis; in-

volucris axillaribus, exsertis, infundibuliformibus, subpedicellatis, margine subundulatis. Columella subhirsuta, involucro longe prominente apice brevi.

Observ. Planta junioribus Trich. pyxidiferi L. exemplaribus affinis, differt vero structura graciliori involucris excavatis, patentissimis, infundibuliformibus, margine subundulatis. . . . Frondes tripollicares, 1–1½ pollices latae, virides . . . .

Crescit in India oriental. Montibus coeruleis Outacamund, . . .— Taschner, loc. cit.

In the Gray Herbarium is a specimen from the Hooker collection, collected by Schmid, fitting this description in everything except size; this may well be a cotype. The involucre is slightly longer than as depicted by Taschner; and I do not find the trichomes present on his figures, but these might well have disappeared with time. The fronds of this specimen are 3 cm, rather than 3 inches in length.

This is the fern figured as *T. Filicula* by Beddome, Ferns of Southern India, Plate 7, later corrected (with Plate 283 of Ferns of British India) to *T. pyxidiferum*, with notation that it is "the *Schmidianum* of Van den Bosch." It falls within the range of the plants called *T. pyxidiferum* in America, but can be distinguished from what I suppose to be that species in a stricter sense by relatively short involucre, with less-dilated mouth and broader wing. I have seen only the one specimen.

Besides the foregoing species, there have been described many either said to be relatives of *T. pyxidiferum* or appearing from the descriptions to be such. I have found the alleged relatives, when known to me by specimens, to belong in various groups, most often in *Gonocormus* or *Taschneria*. Because false veins are critically important in the recognition of groups, but are still often ignored in descriptions, nothing remains but to assume affinity, until specimens are seen. In this manner, I provisionally assign to this group the following three species:

TRICHOMANES MICROCHILUM Baker.

T. microchilum BAKER, Trans. Linn. Soc. Bot. 4 (1894) 250.

Collected at 7,000 feet altitude on Mount Kinabalu, Borneo, *Haviland 1478*. By description, this seems suspiciously like its coendemic, *T. Hosei*, described seven years earlier by the same author.

TRICHOMANES WILDII Bailey.

T. Wildii BAILEY, Queensland Dept. Agr. Bot. Bull. 4 (1891) 19, pl. 5a; Lithograms, Ferns of Queensland 22.

Rhizome slender, tomentose, forming dense masses on bark. Fronds including stipes about 1 in. high, pinnate, with pinnatifid pinnae, stipes

flattened as in *T. Barnardiana*, with a few dark hairs at the very base. Pinnae few, distant, with 3 or 4 linear lobes, veinless except the central costa. Indusium almost free on the upper side of the pinnae some distance from the axil, mouth spreading but scarcely lipped.

Hab.: near Cairns, *C. J. Wild.*—Bailey, loc. cit.

Apparently a distinct species, with some resemblance to *T. draytonianum.*

TRICHOMANES HIERONYMI Brause.

T. Hieronymi BRAUSE, Bot. Jahrb. 49 (1912) 6.

Northeast New Guinea, *Schlechter 19701.* Said to resemble *T. brevipes* in appearance, but to have toothed margin of segments and involucres, no false veins, and wingless stipes. Toothed margins are strongly suggestive of *Leptocionium.*

6. TRICHOMANES HOSEI Baker. Plate 2, figs. 2 to 4.

Trichomanes Hosei BAKER, Journ. Linn. Soc. Bot. 22 (1887) 228, pl. 12.

Rhizomate filiformi late repente, stipite brevi nudo haud alato, frondibus parvis ovato-rhomboideis tripinnatis, pinnis inferioribus maximis deltoideis basi postice cuneato-truncatis, segmentis ultimis linearibus uninerviis integris ascendentibus, soris terminalibus solitariis, involucro infundibulari angusto alato labiis 2 parvis semiorbicularibus praedito, receptaculo breviter exserto. (Plate XII.)

A small finely-cut species allied to the Philippine *T. brevipes*, Baker, and *T. Smithii*, Hook., and Polynesian *T. tenue*, Brack. Fronds about 2 inches long, ½ inch stipe included, erect, spaced out upon the long filiform rhizome. Final one-nerved entire segments about ½ of a line broad, not more than ⅛–¼ in. long. Involucre ¼ in. long, narrowly winged on both sides nearly or quite to the top of the tube.—Baker, loc. cit.

Known to me by a cotype in the Singapore Herbarium. It might well constitute a group by itself, having the involucre of a *Tachneria* but no false veinlets, and cell walls suggestive of *T. cupressoides.*

7. TRICHOMANES COLENSOI Hooker, f. Plate 3.

Trichomanes Colensoi HOOKER, F., Ic. Pl. 10 (1854) 979.

Caudice gracili filiformi elongato, frondibus oblongis acuminatis laxe pinnatis, pinnis subpinnatifidis laciniis brevibus linearibus angustis acutis erecto-patentibus integris vel incisis, involucris solitariis basin versus singulae pinnae insertis infundibuliformibus stipitatis liberis, columella longissime exserta flexuosa.

Trichomanes Colensoi, *Hook, fil, mst.*

HAB. Interior of the Northern Islands, New Zealand, near Waikare Lake, *Rev. W. Colenso, n. 104.*—Hooker, loc. cit.

Stipes remote, 2 to 3 cm long, filiform, wingless; fronds commonly 8 cm long and 2.5 to 3 cm wide, bipinnate, with filiform,

wingless, sometimes zigzag or flexuous rachis; pinnules stalked; cuneate, incised with erecto-patent segments, thin and green; walls thin, straight, uniform; sori in the place of the lowest acropetal pinnules, or less frequently of basal acropetal segments, involucre narrowly winged, truncate. Plate 3, fig. 1, frond, × 1; fig. 2, detail of structure, × 400; fig. 3, sorus, × 15; the sori are often more slender.

New Zealand, both islands, endemic.

2. PHLEBIOPHYLLUM; THE MONOTYPIC GROUP OF T. VENOSUM

8. TRICHOMANES VENOSUM R. Brown.

Trichomanes venosum R. BROWN, Prod. Florae N. Holl. (1810) 159; HOOKER and GREVILLE, Ic. Fil. pl. 78; FIELD, Ferns of New Zealand 71, pl. 14, fig. 4; pl. 18, fig. 3.

Frondibus pinnatis, pinnis linearibus venosis crenato-repandis: inferioribus basi lobatis v. pinnatifidis intusque unifloris. (D. J.). *v. v.*—Brown, loc. cit. [J signifies Port Jackson; and D, Tasmania.]

An epiphyte on trunks of *Dicksonia,* or on mossy logs, etc., rhizome coarsely filiform, 0.3 mm in diameter, dark, hairy; stipes seriate but approximate, 1 to 3 cm long; frond commonly 4 to 6 cm long, lanceolate to obovate or broadly elliptic, pinnate with wingless rachis; pinnæ most variable, ranging on single fronds from ovate and 1 cm long to linear, 3 cm long by 2 mm wide, the lowest short-stalked, the upper adnate, the lower ones commonly with a basal acropetal lobe, membranaceous, glabrous; costa flexuose, veins forked, sometimes twice, or in broad pinnæ several times, without false veinlets or specialized margin; sorus one on a pinna, on the upper side at the base, the tubular involucre commonly half-immersed, the upper half winged, mouth strongly dilated, receptacle long-exserted. With pinnæ of the short form only, this is *T. venustulum* Colenso.

An isolated species, with some affinity to the group of *T. pyxidiferum,* and to American rather than to the Oriental representatives of the group. As a component of the vegetation, it occupies the place taken by *T. pallidum* in the Malay region.

Apparently common in New Zealand and Tasmania, and eastern Australia north to Queensland.

3. PLEUROMANES; THE GROUP OF TRICHOMANES PALLIDUM

A group characterized in its full and typical development by a pad of tissue several cells thick inclosing the costa and extending more or less of the way to the margin; by the presence of long, white hairs on this pad; by glaucescence, sometimes

sufficient to color the frond white or blue; and by a specialized margin, the cells of which are not essentially elongate, nor with very oblique walls. Epiphytes on trunks or rocks, usually with long, weak stipes, the fronds pendent and forming mats. From the Himalayas across Polynesia.

Key to the species.

Axial pad wanting ..... 9. *T. latifrons.*
Axial pad narrow, frond naked or nearly so..... 10. *T. acutum.*
Axial pad evident, frond commonly hairy..... 11. *T. pallidum.*

9. TRICHOMANES LATIFRONS van den Bosch. Plate 4.

T. latifrons VAN DEN BOSCH, Ned. Kruid. Arch. 5 ' (1863) 209.
T. cupressifolium HAYATA, Ic. Pl. Formos. 4 (1914) 136, fig. 73.

Fronde oblonga vel lanceolata acuminata bipinnatifida; laciniis primariis erecto-patulis remotiusculis anguste oblongis pinnatifidis, secundariis (lacinulis) erecto-patulis remotis subsimplicibus late linearibus parum elongatis, apice angustato rotundato, margine leviter undulato; rhachi alâ lata undulata deorsum angustatâ marginata venisque et venulis concoloribus; cellulis diaphanis teneriusculis mediocribus (facile magnis) inaequalibus subregularibus elongato-hexaëdris acutangulis, parietibus hyalinis rectis tenuibus, interaneis globulosis, globulis diffusis minutissimis glomeratis densiusculis pallide flavescentibus, marginalibus semi-hexaëdris elongatis, soris majusculis in laciniis secundariis parumper abbreviatis immersis, indusio ventricoso utrinque ala lata undulata marginato in limbum patulum undulatum sensim leviter expanso, receptaculo parum (?) elongato; stipite 2–3 centim. longo apice angustissime alato vel terete concolore. Rhizoma horizontale setaceum parce ramosum atro-fusco-tomentosum; frons 1 decim. circiter longa, 3 fere centim. lata membranacea teneriuscula diaphana fuscidula.

Habitus quaedam intercedit cum *T. glaucofusco* HOOK. similitudo, attentius vero comparatum mox pluribus notis distinctum esse patet nostrum, v. g. limbi opaci juxta venas venulasque, pilorum, glaucedinis defectu, etc.

Hab. India orientalis (Khasya),-? (Herb. HOOK.)—Van den Bosch.

This resembles not the real *T. glaucofuscum* Hooker (*T. pallidum* Blume), but the Philippine plant, *T. acutum* Presl. To the latter it has both resemblance and affinity, but is distinguished, beside in a measure by the points noticed by van den Bosch, by the absence of any marginal line.

Several specimens in the United States National Herbarium and Gray Herbarium, collected by Hooker and Thomson in Khasya, and sent from Kew as *T. gracile* Moore (it does not seem to be *T. gracile* van den Bosch), represent this species. There is also in the Gray Herbarium a specimen from Bhotan, *ex* herb. Griffith, from Kew; as this is named *T. latifrons*, in spite of the fact that the species was not recognized by Hooker and Baker, I suspect that it is a cotype. These are identical

with *Faurie 306* and *625*, from Mount Arisan, Formosa, the type locality of *T. cupressifolium*, which they surely represent. *For. Bur. 16318 Curran, Merritt, and Zschokke*, from Mount Pulog, Luzon, which I marked as new when it was collected in 1909, is also this species.

Hancock 138, from Yunnan, distributed as *T. pyxidiferum*, is thinner and has a narrowly winged involucre; it is near to this species, if not identical.

Trichomanes latifrons and *T. acutum* form a series connecting the generalized and not strictly existent *T. pyxidiferum* of the Orient with the highly specialized *T. pallidum*, and may reasonably be regarded as representing steps in the evolution of the last species, whatever the exact ancestor of the series as a whole.

10. TRICHOMANES ACUTUM Presl.

T. acutum PRESL, Hymenophyllaceae (1843) 134.
Pleuromanes acutum PRESL, Epimeliae (1849) 258.
T. fuscoglaucescens HOOKER, ex J. Smith, Journ. Bot. 3 (1841) 417, nomen, meant to be *T. glaucofuscum*.
T. glaucofuscum HOOKER, Sp. Fil. 1: 128, as to the Luzon plant, pl. 40 A.

T. fronde oblongo-lanceolata obtusa glaberrima profundissime bipinnatifida basi pinnata, laciniis primariis pinnisque oblongo-lanceolatis acuminatis, secundariis oblongis, bi-trilobis, lobis linearibus acutis mucronulatis integerrimis, soris exsertis, indusii limbo patente integro, receptaculo recto.

Cuming pl. exs. philip. n. 219.

Habitat in insulis philippinis, praesertim in insula Luzon, ubi legit clar. Cuming.—Presl, Hymen. 134.

The frond is usually lanceolate rather than oblong-lanceolate, acute rather than obtuse, glabrescent instead of very glabrous; the rachis is narrowly winged to the base; the segments are usually but not always acute; the base of the involucre is usually distinctly immersed; and the receptacle is curved if full-grown and intact, which is a rare condition in herbarium specimens.

The fronds are large and long, 20 to 30 cm in length; the axial pad is contracted to a thick-walled cortex such as occurs generally in the genus; it is therefore naked as compared with *T. pallidum*, but young fronds bear a few long hairs like those of that species; the involucre is 2 to 2.5 mm long, with a flaring mouth 1.5 mm wide. Otherwise it is like the plants of Polynesia and Ceylon, with which Hooker, at that time not knowing *T. pallidum*, confused it as *T. glaucofuscum*.

Known only from the mountains of northern Luzon, *Cuming 219* (type), in Gray Herbarium (two sheets), United States Na-

tional Herbarium, and Bureau of Science herbarium; *Bur. Sci. 19619, 19679, 37518, 37732, 37761, 40409; Merrill 7813; Topping 200.*

11. TRICHOMANES PALLIDUM Blume.

T. pallidum BLUME, Enumeratio (1828) 225.
Pleuromanes pallidum PRESL, Epim. 258.
Craspedoneuron pallidum VAN DEN BOSCH, Hymen. Javan. 14, pl. 8.
T. album BLUME, Enum. 226.
Leucomanes album PRESL, Epim. 258.
Craspedoneuron album VAN DEN BOSCH, Hymen. Javan. 12, pl. 7.
T. glaucofuscum HOOKER, in Nightingale's Sketches 131; Sp. Fil. 1: 128, except as to the Luzon plant.
Craspedoneuron Braunii VAN DEN BOSCH, Hymen. Javan. 15, pl. 9.
T. savaiense LAUTERBACH, Engler's Jahrb. 41 (1908) 218.

T. fronde bipinnatifida oblonga sparsim setosa glaucescente (plant. jun. pinnatifido-digitata), pinnis subalternis cuneato-oblongis pinnatifidis, laciniis cuneiformibus subbifidis, lacinulis linearibus obtusis emarginatis, rachi alata, stipite tereti glabro.

Obs. Maxime affine *Tr. lucenti*, Sw.

Crescit ad truncos arborum in Javae sylvis primaevis.

Var. B. *Glaucum*, pinnis suboppositis approximatis pinnatifidis, laciniis linearibus obtusis emarginatis.

Crescit in arboribus Provinciae javanicae Bantam.—Blume, loc. cit.

Trichomanes album Blume, Enum. (1828) 226:

T. fronde bipinnatifida ovato-oblonga strigosa albida, pinnis oppositis alternisve cuneato-lanceolatis pinnatifidis, laciniis cuneiformibus incisis, lacinulis linearibus subbifidis, rachi marginata, stipite tereti glabro.

Crescit in Javae montibus excelsis.

This is one of the most distinct species in the genus—after the removal of *Cardiomanes*, and dealing only with the Old World. The margin, responsible for van den Bosch's generic name, *Craspedoneuron*, is peculiar, and apparently far from uniform—compare the figures of van den Bosch, Hymen. Javanicae, pl. 10, and of Mettenius. A marginal row of small, more or less elongate cells, apparently thin-walled, is sometimes evident. The next row inward has thick, dark walls, and may be two cells in depth.

The veins are immersed in a broadly flattened strand or pad of thick-walled cells, which, misinterpreted, was responsible for Presl's first generic name, *Pleuromanes*. This pad is several cells thick in the middle, and thins to two toward the margin. Van den Bosch, giving more accurate definition to Blume's two species, *T. pallidum* and *T. album*, assigned to the latter the specimens with a one-cell-thick wing a couple of cells wide,

between the pad and the specialized margin; to the former, the specimens with the wing half a dozen cells wide; specimens with a still wider wing, and correspondingly narrow pad, constituted his third species, *T.* or *C. Braunii.* Confining attention to Javan specimens, with which alone he dealt, I cannot see that they fall into distinct groups. Rarely, the wing is obsolete, the pad extending to the submarginal strand; elsewhere on the same fronds the wing is one, two, or three cells wide. On other fronds, it varies from 2 to 4 or 5 cells, or from 3 to 6, 5 to 9, etc. I find no correlation between the width of the pad and any other character except the pubescence. Accordingly, I regard the three Javan "species" as one. Beyond Java, the commonest form is the typical *T. pallidum* in Sumatra, Borneo, the southern Philippines, and Papua. Farther north and east, in Ceylon, the Peninsula, the central Philippines and Luzon, and from New Caledonia to the Marquesas, it is *T. Braunii,* with narrow axial pad and correspondingly naked fronds, whether or not strongly glaucous.

Presl's second generic name, *Leucomanes,* published without a diagnosis, may refer to either or both of the remaining striking characteristics of the species. The fronds are glaucous, the glaucousness varying from almost obsolete to a dense white or bluish granular coating; and they are hairly, with hairs consisting of one cell above the base, usually 0.2 to 0.5 mm long, but sometimes reaching 1 mm. When short, the hairs are rigid; long ones may be weak. They are restricted to the pad and margin, wherefore *T. Braunii* represents the most-naked form, and *T. album* the most hairy; but, even when the pad is widest, the hairiness is very variable in density and in persistence.

Rhizome wide-creeping or intricate, on mossy trunks, 0.2 to 0.3 mm in diameter, hairy or glabrescent; stipes wiry, terete, dark, glabrescent, commonly 5 cm long; fronds pendent, flaccid, ovate if small, lanceolate if large, commonly 5 to 20 cm long, bipinnatifid with simple or forked segments, the rachis winged by decurrent pinnæ, narrowly toward the base of slender fronds; sori on shortened basal acroscopic segments, with tubular involucre 1 to 1.5 mm long, truncate or slightly dilated and undulate, the base more or less immersed, the wing often obsolete toward the mouth. Polynesian specimens average larger than Malayan, beside being relatively thin and naked; they are *T. glaucofuscum* Hooker, based probably on a Huahine collection. I have not seen authentic *T. savaiense,* nor any frond as much as

40 cm long; but specimens collected in Samoa by Whitmee, Reinecke, Powell, and Betche, reaching a length of 25 cm, are *T. pallidum*, or *T. glaucofuscum* if one will, and indistinguishable from those of Tahiti and Ceylon, or exceptionally large ones from any part of the range of the species.

Common in the mossy forest, throughout the Malay region and to central Luzon (rare in northern Luzon); Ceylon; Amboina; Papua; New Caledonia; Samoa; Society Islands; Marquesas (*Bertero*).

4. GONOCORMUS; THE GROUP OF TRICHOMANES PROLIFERUM

Rhizome and stipe dark, wiry; fronds minute, flabellate in plan and venation, simple but incised between the veins, sometimes nearly to the base, with short, narrow, firm, dark green segments, usually emarginate, without false veins, specialized margin, or hairs; sori immersed in the apices of the segments, with elongate, sometimes ventricose tube and flaring mouth. The most striking peculiarity of the group is the lack of differentiation of rhizome and stipe shown by the presence, at least on strong fronds, of a bud at the top of the stipe—respectively, the base of the frond—which can produce a stipe bearing another frond, or even, rarely, produce a rhizome. As this process may be repeated several times, the definition of the frond becomes an arbitrary matter; except in the exceptional case in which the bud produces a rhizome, of unlimited growth, I find it convenient to treat the original frond and its derivatives, of limited number, as one frond, and to designate the several laminæ as "part-fronds." Only the upper members of such a series are usually soriferous. Mettenius, Über die Hymen. 406, seemed to believe the adventive bud a constant character of the group, by which a *Gonocormus* could be recognized even in the absence of actual proliferation. I have been able to detect it on some, but not on most, simple fronds. That emphasis belongs on the lack of differentiation of rhizome and stipe, rather than on the buds, which illustrate this lack, is shown by the occasional formation of terminal fronds on rhizomes typical up to that point. The distal part of a compound frond may be pinnate, instead of dichotomous, in plan; and so, less conspicuously, may be a simple frond. This occasional pinnate branching, and the form of the involucre, indicate affinity to the group of *T. pyxidiferum*. Although *Gonocormus* is a tenable genus, if one will, its affinity to the body of *Trichomanes*

is clear, but there is no near affinity to *Microtrichomanes*. The range is from Fernando Po, west of Africa, to Hawaii, north to Japan, and south to Australia.

Within the group, the species are very ill-differentiated. The range in size and in form, depending chiefly upon the degree of proliferation, is so great that if attention be directed to the differences, as naturally happens when but few specimens are known, there seem to be a number of easily distinguishable species. With the accumulation of material, these blend, until I doubt there being a species in the group which does not intergrade with the others. In fact, I believe that specimens typical of every described species are found on the very limited area at the summit of Mount Maquiling, in central Luzon, but feel sure that all of these specimens represent a single species. As a matter of botanical philosophy, I believe that two (or more) species which are reasonably uniform and distinct in Java are good species in Java, and that the propriety of so recognizing them is not seriously impaired by their blending in Luzon. Chiefly on this ground, and in minor part in deference to established usage, I present the Javan species recognized as such by van den Bosch in his Hymenophyllaceae Javanicae, with a key based on the conventional distinctions.

Besides the species I have recognized or reduced, there are two described from New Guinea, *T. novo-guineense* Brause, Bot. Jahrb. 49 (1912) 7, and *T. subtilissimum* Brause, Bot. Jahrb. 56 (1920) 33, known to me by description only; because of the instability and polymorphism of all *Gonocormus* species, I mistrust them, but they may easily be as distinct and stable as those I recognize.

There is also in Samoa a *Gonocormus*, represented in the Gray Herbarium by *Powell 102*, collected in 1863, far more sharply distinct from the local form of *T. parvulum* than is any Javan "species" from any other. In Java or Sumatra, it might be construed as *T. Teysmannii*. In Samoa, it is a distinct species. So far as *T. Teysmannii* is concerned, I would describe and name it, in spite of my hesitancy to regard any *Gonocormus* as distinct, but abstain because of the possibility that it is a large *T. novo-guineense*. The fronds are mostly about 6 cm long and 2.5 cm broad, but variable in the manner of the group. Few of those seen are proliferous. The architecture is pinnate throughout, except as disturbed by the proliferation.

Key to the species.

Sori on ordinary fronds or part-fronds.
- Axes not proliferous ..... 12. *T. parvulum.*
- Axes proliferous.
  - Proliferations scanty.
    - Segments plane ..... 13. *T. minutum.*
    - Segments somewhat folded ..... 14. *T. diffusum.*
  - More conspicuously ramose.
    - Lateral walls uniform ..... 16. *T. Teysmannii.*
    - Walls irregularly thickened ..... 15. *T. proliferum.*

Sori in a long apical "raceme"..... 17. *T. alagense.*

12. TRICHOMANES PARVULUM Poiret. Plate 5.

T. parvulum POIRET in Lam. Enc. 8 (1808) 64; HOOKER, Sp. Fil. 1: 118, pl. 39A; OGATA, Ic. Fil. Japon. pl. 199.

T. saxifragoides PRESL, Hymen. 131.

T. thouarsianum PRESL, Hymen. 132.

T. subpinnatifidum VAN DEN BOSCH, Ned. Kr. Arch. 5 (1861) 141; Journ. Bot. Néerl. 1 (1861) 345; Meded. Rijks Herb. 17 (1913) 25, fig. 14 (based on a Ceylon specimen collected by Gardner).

T. Mannii HOOKER, Synopsis Fil. (1867) 75.

T. musolense BRAUSE, Bot. Jahrb. 53 (1915) 377.

Trichomanes pusillum, frondibus minimis, variè dissectis, patentibus, glaberrimis; laciniis apice subdichotomis, obtusis; fructificatione compressâ, terminali, urceolatâ. (N).

Cette espèce . . . n'a guère que trois à quatre lignes au plus de haut; . . . ses pétioles . . . supportent une petite feuille simple, membraneuse, verdâtre, très-glabre, transparente . . . divisée presque jusqu'à sa base en découpures très-inégales, courtes, presque linéaires, entières ou bifurquées . . .

. . . recouillie par M. du Petit-Thouars à l'île de Madagascar.—Poiret, loc. cit.

I have seen no Madagascar specimen referable to this species, but have specimens of other origin from the Paris Museum and from Prince Bonaparte, which ought to be authentic. What I construe as the typical form has fronds about 1 cm in diameter, reniform or circular when sufficiently branched to produce this form, or fan-shaped if more simple, the margin shallowly incised between the ultimate veinlets, and more deeply between the groups of veins, with a more or less marked tendency of the medial segments to exceed the lateral ones and thus produce ovate or moderately elongate fronds; stipe more or less as long as the frond; sorus immersed in the tips of segments, the involucre narrowly campanulate or longer and moderately ventricose, the mouth dilated or flaring but not bilabiate.

Very variable in size and shape. *Trichomanes saxifragoides* was founded on *Cuming 256*, from Luzon, of which cotypes are in the Gray Herbarium, United States National Herbarium, Bureau of Science, and my own herbarium. It is a minute form, the largest fronds sometimes not over 5 mm in diameter, usually flabelliform or less than semicircular, with few segments. It is not rare in the Philippines, and varies greatly in the depth of the incisions. The sori may be on short segments, as stated by van den Bosch, Hymen. Javan. 9, and thus fall short of the general contour of the frond, or they may be on the longest segments, as stated by Presl. The sori are small, proportionate to the fronds. On these minute fronds, the tendency is for the segments to approximate equality; still, as Presl recognized, the central segments may be preferred. I have tried to find a line between these minute forms and typical *T. parvulum*, tentatively using 8 mm as a boundary, but have come to the conclusion, with the accumulation of Philippine material, that any line is arbitrary. There are no distinctions except in size or in correlation with size, and in size it blends in the Philippines with the forms which have been recognized as *T. parvulum* or called *T. minutum*. As the type is Philippine, the species falls when found inconstant there. Similar minute plants have been given this name in Indo-China, Borneo, Rawak, New Caledonia, Fiji, and Hawaii, and can probably be found whenever *T. parvulum* occurs.

The larger forms of *T. parvulum* vary more widely, in form as well as in size. Some collections are composed of almost uniform, beautifully round fronds: *Bur. Sci. 17654 Ramos*, from Samar, with many reniform to circular, flat fronds 12 mm in diameter overlying an older crop with folded segments which, by themselves, could be *T. saxifragoides*. Japanese collections are likely to be fairly uniform, but semicircular rather than more fully rounded out. In most lands, the segments tend to be more unequal, and ovate or elongate fronds predominate, however broad the base may be. A width of more than 12 mm and a length of 2 cm are unusual, but abnormal fronds may double these dimensions; and with exceptional inequality in the development of the axes of growth, there is hardly a limit to the forms the fronds assume.

Typically and usually, *T. parvulum* is not proliferous. However, I have been able to detect some proliferation in specimens from every land whence I have seen the plant. It is commoner on the larger and less symmetrical forms; but even in the type

collection of *T. saxifragoides* I have found fronds with only half a dozen segments with a narrowly cuneiform bifid appendage on the "stipe."

Trichomanes subpinnatifidum and the *Hymenophyllum Gardneri* with which it was found mixed are overlooked or ignored by Hooker and Baker, Thwaites, Beddome, and Wall. Specimens collected in Ceylon by Ferguson, by Naylor Beckett, and by Thwaites conform reasonably to van den Bosch's description; they are distributed, correctly, as *T. parvulum.* Also, van den Bosch's figure, Meded. Rijks Herb. fig. 14, represents *T. parvulum* as far as it goes; in particular, the very thin outer wall of the marginal cells is more correctly drawn than in any of his figures in Hymenophyllaceae Javanicae.

I do not know whether or not *T. parvulum* and *T. thouarsianum,* based on a Thouars collection ascribed to Bourbon, were described from the same collection; at any rate it occurs in Madagascar (Bonaparte, Notes Pterid., Fasc. 16: 14, 158) and the other East African islands; Africa: *Dümmer 1221* in the United States National Herbarium, from Uganda; and thence practically everywhere to Korea and Japan, the Malay region, Papua, New Caledonia, Australia, Fiji, Samoa, Tahiti, the Marquesas, and Hawaii.

The Marquesas plant, *Mumford and Adamson 361,* is small but notably proliferous. I do not consider it possible to regard it as *T. proliferum,* as a proper species distinct from *T. parvulum;* if distinguished at all from the latter, it must be as a species of evolution parallel to that of *T. proliferum,* and it may be characterized further by having a notably wide, flat mouth of the involucre.

In the posthumous publication of the notes left by van den Bosch, Meded. v.'s Rijks Herbarium, No. 17 (1913), *T. thouarsianum* appears on page 19 as a synonym of *T. parvulum* and on page 22 as an independent species. The figure 9, page 19, is quite certainly not this species, but *T. sibthorpioides,* cited by van den Bosch as a synonym. With only a sterile specimen, the confusion was easy.

Trichomanes Mannii [= *T. mannianum* Mett. in Kuhn, Fil. Afric. (1868) 34], represented by a cotype in the Gray Herbarium, is distinct from *T. parvulum* in no respect unless it be in size, reaching a width, on the sheet seen, of 2 cm and a length of 3 cm. Among the species of the Malay region, it is most exactly duplicated by *T. diffusum,* but it seems more reasonable to reduce it to *T. parvulum* than to postulate a remarkably

discontinuous distribution for *T. diffusum*, while I regard the distinctness of that species in any place as questionable. Exceptional specimens of *T. parvulum* from other places are as large as are the Fernando Po specimens. The "broad plaited wing all round the mouth of the involucre" (Syn. Fil. 76) is merely the moderately overfull dilated mouth of the involucre common in the group, well shown by van den Bosch's figure of *T. diffusum*, Hymen. Javan., pl. 4. *Trichomanes musolense* was also described from Fernando Po, recognized as a relative of *T. proliferum*, and provided with a description which does not differ essentially from that of *T. Mannii*, except in length.

Finally, every detail in the description of *T. gracile*, known to me, as to van Alderwerelt, by description only, marks it as a *Gonocormus*, indistinguishable from a nonproliferous *T. Teysmannii*. It may be reduced to the latter, or to *T. parvulum;* and I suppose that *T. melanotrichum* Schlecht. may suffer the same fate.

13. TRICHOMANES MINUTUM Blume.

Trichomanes minutum BLUME, Enum. (1828) 222.
Gonocormus minutus VAN DEN BOSCH, Hymen. Javan. 7, pl. 3.

T. fronde (subbinata aut ternata) longe stipitata, foliis petiolatis subrotundis basi cuneatis palmato-incisis glabris, laciniis linearibus obtusis bifidis.

Obs. A priori [T. parvulum Poir.] differt fronde longe stipitata basi cuneata et laciniis plerumque bifidis aut bipartitis.

Crescit in Javae montibus ad arborum truncos muscosos.—Blume, loc. cit.

In this species, van den Bosch included Blume's *T. parvulum* and *T. bifolium*, but modified the description to make it include moderately proliferous plants with plane segments. As Blume construed as fronds what I call "part-fronds," this modification was only apparent, and entirely reasonable. From the considerable number of collections in hand, and having myself undertaken to identify and distinguish Blume's species on Mount Gedeh, I agree with van den Bosch that the three Blumean species blend and are one. It is also my observation that proliferation is commoner here than in lands where *T. parvulum* is more typical in its character. This is the whole of the difference; *T. minutum* is prone to moderate proliferation, which is rare in *T. parvulum*.

Distinguishing them in this manner, *T. minutum* is common in Java and the Peninsula, and probably throughout the Malay region, and not rare in the Philippines.

14. TRICHOMANES DIFFUSUM Blume.

Trichomanes diffusum BLUME, Enum. (1828) 225.
Gonocormus diffusus VAN DEN BOSCH, Hymen. Javan. 9, pl. 4.

T. fronde bipinnatifida diaphana glabra, pinnis alternis vel oppositis remotis lanceolatis, infimis stipitatis, superioribus confluentibus, lobato-pinnatifidis, laciniis linearibus obtuse dentatis, receptaculis solitariis geminisve, rachi superne marginata, stipite tereti glabro.

Crescit in montanis Javae locis muscosis.

Var. B. pinnis omnibus sessilibus, laciniis subintegerrimis, rachi tota marginata.

Crescit in monte Tidore insulae.—Blume, loc. cit.

Trichomanes diffusum Bl. (excl. var. B) diff. a T. minuto: frondiculis e basi cuneata obovatis oblongisve complicatis, lacinulis semper pinnatifidis, sororum forma et magnitudine fere duplo, cellulis multo majoribus caet., a *T. prolifero* statura minore, rhachi alata, indusio ventricoso, cellulis tenerioribus majoribus fuscis caet.—Java, in m. Gedé Bl., Insula Marchesas: Lepine.—Van den Bosch, Journ. Bot. Néerl. 1 (1861) 345.

Blume distinguished this from *T. minutum* by its being pinnate rather than flabellate in plan; but this distinction is at best one of degree, neither "species" being fixed in the character ascribed to it. I have keyed them apart by one of van den Bosch's distinctions; namely, that the segments of *T. minutum* are plane, while those of *T. diffusum* are prone to fold upward, on the costa as an axis, or to become variously contorted. This is correlated with a microscopic difference in structure, the cell walls of his *T. minutum* being broadly pitted, the narrow divisions between the pits looking like teeth. I am not yet sure on this point, but it is my impression that the partial thickening of the walls is under the direct influence of the environment, so that the fronds of a single plant may show it in one season and not in another. The ability to react in this way seems to me to be a characteristic of *Gonocormus*, and not to distinguish any of its supposed species.

I do not believe that even convenience is served by maintaining *T. diffusum* as a species distinct from *T. minutum*.

Trichomanes subtrifidum Matthew and Christ, Journ. Linn. Soc. Bot. 39 (1909) 214, described as a dwarf relative of *T. pyxidiferum*, was found on Mount Maquiling, altitude 3,000 feet, where *Gonocormus* is a riot of forms, common and bizarre. Without seeing the type collection, I feel sure that it is one of these, and that none of them, however distinct in individual aspect, is a good species. By description, it would reduce best to *T. diffusum;* but I prefer to be more thorough, and regard it as a peculiar form of *T. parvulum*. Plate 5, figs. 4 and 5, shows two fronds on the same rhizome, from a Yunnan specimen,

Hancock 136, U. S. Nat. Herb. 1277595. The larger of these fronds suggests the description of *T. subtrifidum.* I illustrate this, rather than a Maquiling specimen, to show that such behavior is not a local phenomenon.

15. TRICHOMANES PROLIFERUM Blume.

T. proliferum BLUME, Enum. (1828) 224; HOOKER, Sp. Fil. 1: 118, pl. 39B.
Gonocormus prolifer PRANTL, Hymen. 51.
T. palmatum PRESL, Hymen. 131.
Gonocormus palmatus VAN DEN BOSCH, Hymen. Javan. 11, pl. 6.

T. fronde (subbinata aut ternata) longe stipitata subrotunda basi cuneata palmato-incisa glabra, laciniis pinnatifidis.

Obs. A praecedentibus [T. parvulum and T. minutum] differt laciniis pinnatifidis.

Crescit in truncis arborum Javae.—Blume, loc. cit.

The sole distinctive feature of this species is its comparatively free proliferation, the series of successive part-fronds running commonly to about four; and it is not rare for two (or even three) secondary stipes to spring from the base of one part-frond. The luxuriance of these plants finds another expression in a marked tendency to pinnate development of the part-fronds. With the understanding that it intergrades with *T. minutum,* it remains convenient to give specific status to this luxuriant form. It is probably common throughout the Malay region.

Philippine specimens may be exactly like Javan, but have a clearly marked tendency toward restriction of the sori toward the apex of the frond, and the reduction of the lamina there. This tendency is independent of the proliferation, appearing either on the upper part-fronds or on nonproliferous fronds of the same cultures. Where it occurs, the local frond plan is pinnate. To the extent that this distinction between the races in Java and Sumatra, and in the Philippines is a fixed one, *T. proliferum* and *T. palmatum* are distinct species. If either were clearly, instead of vaguely, distinct from *T. parvulum,* I would treat them as distinct from one another.

The common Peninsular form has also its own varietal character, both the fronds as a whole and the part-fronds averaging distinctly smaller than in Java and Sumatra.

16. TRICHOMANES TEYSMANNI van den Bosch. Plate 6, figs. 1 to 3.

Trichomanes Teysmanni VAN DEN BOSCH, Ned. Kruid. Arch. 5 [2] (1861) 142.
Gonocormus Teysmanni VAN DEN BOSCH, Hymen. Javan. (1861) 10, pl. 5.

Frondiculis e flavo virescentibus diaphanis lanceolatis vel lineari-lanceolatis bipinnatifidis, laciniis primariis subpatulis remotiusculis subrhombeis saepe elongatis, secundariis erectis contiguis furcato-flabellatis, lacinulis fastigiatis e cellulis magnis hyalinis elongato-hexaëdris viridiglobulosis contextis, rhachi anguste alata, soris latiuscule marginatis, indusio cylindrico-ventricoso, limbo amplo patente subundulato, stipite fronde subtriplo breviore apice anguste alato.

Hab. ad arborum truncos muscosos in littore occidentali Sumatrae, *Teysmann.*

. . . Stipes apice anguste alatus, caeterum filiformis teres glaber 5–15 millim. longus; frondes secundariae s. ex stipite s. ex rhachi angulo plerumque obtuso vel recto exeuntes 2–5 centim. longae, 5–8 millim. latae frondi primariae, usque 5 centim. longae et 12–15 millim. latae, excepta magnitudine, universe conformes . . .

Species formae gracilitate et contextu tenero insignis, ab antecedentibus [G. minuto et G. diffuso] longe recedens, sequenti [G. palmato] proxima, a qua vero facile distinguitur: habitu, divisione frondis, rhachi stipiteque apice alatis, cellulis minoribus teneris globulosis, indusio breviore magis ventricoso, etc. . . .—Van den Bosch, Hymen. Javan., loc. cit.

Such distinctions as van den Bosch thought to exist are presented in the foregoing quotation. They do not appeal to me as very real. Aside from the dubious gross distinctions, *T. Teysmannii* should have plane and smooth laminar cell walls, while *T. proliferum* should have them irregular and pitted or toothed; my view of this feature is stated in the discussion of *T. diffusum.*

Specimens conforming to the description of *T. Teysmannii* occur in Java, Sumatra, and the Peninsula.

Recognizing plural species of *Gonocormus, T. Teysmannii* is the best one to which to assign some anomalous Javan specimens which, by the terms of the usual gross diagnosis, would seem to be *T. pyxidiferum,* but which a more understanding inspection shows to be *Gonocormus.* Such are a collection by Hallier from Tjipinas, *Raciborski 62b* from Tjiapoes (both received in Manila from Buitenzorg as "nov. sp."), and *Palmer and Bryant 596* and *677,* in the United States National Herbarium with my own determination as *T. pyxidiferum;* also *Mousset 5,* distributed with the same name, and *Yates 670,* distributed as *T. bipunctatum.* All are large for the group, lanceolate in major part, and with only a trace of proliferation. Fronds of the Palmer and Bryant specimens reach a maximum length of 13 cm, and fertile ones vary in shape from 60 by 9 mm to 33 by 22 mm. Some fronds on all specimens exactly match some of those figured by van den Bosch for *T. Teysmannii.* To one disposed to recognize many species of *Gonocormus,* these might well represent still another.

17. TRICHOMANES (GONOCORMUS) ALAGENSE Christ. Plate 6, figs. 4 to 7.

Trichomanes (*Gonocormus*) *alagense* CHRIST, Philip. Journ. Sci. 3 (1908) Bot. 270.

In genere egregium fronde fere lineari, ad basin solummodo pinnatifida, sed versus apicem in spicam elongatam urceolarum pedunculatarum elegantissime producta. Species minuta caespitosa.

Rhizomate intertexto-filiformi setuloso nigro, foliis approximatis, caespitosis, stipite capillaceo nigro 2 cm longo debili, fronde e basi latiori lineari-lanceolata 3 ad 4 cm longa, basi pinnis 4 aut 5 utrinque confertis cuneato-flabellatis 0.5 cm longis et latis, profunde bipinnatisectis munita, lobis ultimis vix 1 mm latis, ca. 7, obtusis, nervis flabellatim furcatis, in lobis singulis, nigris; fronde versus medium in spicam linearem contracta, rhachi filiformi sed tenuissime alata, urceolis 10 ad 12 pedunculatis alternis campanulatis, pedunculis 2.5 mm longis, inferioribus furcatis, urceolis 1.5 mm longis eleganter campanulatis, margine tenuissimo cinctis, ore dilatato, receptaculo exserto.

MINDORO, Alag River. *Merrill 6062*, November, 1906.

Ab omnibus *Goniocormis* ab Van den Bosch pictis spica terminali discrepans, potius *G. Teysmanni* V. d. Bosch Hym. Jav. *t. 5* comparanda.—Christ, loc. cit.

This should be compared with *T. palmatum* Presl, not with *T. Teysmannii.* The tendency of the sori to crowd to the distal end of the frond, where the lamina is reduced, is carried farther, making *T. alagense* the end of this evolutionary line. This species is more distinct than are any of those immediately preceding, but even in this case I have collections from Mount Maquiling and from Rizal which may with about equal propriety be called *T. parvulum, T. proliferum,* or *T. alagense.*

DOUBTFUL SPECIES OF GONOCORMUS

TRICHOMANES NOVO-GUINEENSE Brause, Bot. Jahrb. 49 (1912) 7.

Eutrichomanes. Rhizoma repens, filiforme, pilosum, folia densa petiolata interdum prolifera emittens. Petioli tenuissimi, angustissime alati, usque ad 3,5 cm longi, glabri. Laminae membranaceae, pellucidae, glabrae, cr. 3,2 cm longae, 1,8 cm latae, ambitu sublanceolatae, in apicem brevem furcatum desinentes, basi vix angustatae, bipinnato-pinnatifidae; pinnis primariis petiolatis, pinnato-pinnatifidis, patentibus, cr. 6-jugis, alternis, cr. 4 mm distantibus, medianis maximis 1,2 cm longis; pinnis secundariis basalibus supra inferiorum pinnarum primariarum costam petiolatis, profunde unijuge pinnatifidis, cr. 0,7 cm longis, 0,9 cm latis; segmentis cuneatis, incisis, apice obtusiusculo crenulatis; rachibus petiolis similibus angustissime alatis, glabris; costis nervisque validis; nervis simplicibus vel furcatis. Sori superiorem laminae partem occupantes, pauci, plerumque 2-jugi, bini in utroque rachis latere, petiolati (petiolis cr. 2 mm longis), marginati; indusiis 1,5–2 mm longis, orificio dilatato cupuliformibus, ramis nervi furcati inclusis; receptaculo brevi, tenui.

* * * * * * *

Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, Lager Hochmoos, 65 km südwärts der Tami-Mündung, 1600 m ü. M. (L. Schultze n. (33) 35.—Juli 1910).

Steht dem Habitus nach *T. Colensoi* Hook. nahe, die Form der Sori ist sehr ähnlich, aber bei letzterem sind die Fiederabschnitte weniger zerteilt. Sehr auffallend bei der neuen Art ist, dass sie ähnlich wie *T. proliferum* Bl. proliferiert . . .

Trichomanes subtilissimum Brause, Bot. Jahrb. 56 (1920) 33.

Eutrichomanes proliferum. Rhizoma repens, tenuissimum, nigrum, pilis brevibus articulatis brunneis instructum, folia petiolata interstitiis 1–4 mm longis emittens. Petioli tenuissimi, 2–6 mm longi, saepe flexuosi, virides, ad basin versus brunnescentes, juventute basi pilis iis rhizomatis aequalibus, sparsis praediti, frequenter proliferi. Lamina ambitu lineari-lanceolata, basi vix angustata, in apicem obtusiusculum soriferum desinens, 0,6–2,4 cm longa, 0,5–0,7 cm lata, pinnato-pinnatifida; pinnis 8–11-jugis, petiolulatis, interstitiis 2–2,5 mm longis remotis, patentibus, alternis, dimidiatis, maximis 0,4 cm longis, 0,3 cm latis, ambitu flabelliformibus, usque ad costam pinnatifidis; segmentis 2–3, dichotomis vel furcatis; laciniis linearibus, angustissimis, margine subintegris, raro minute denticulatis; rachibus filiformibus, glabris, interdum proliferis. Sori in specimine singuli in utroque rachis apicis latere, indusio cylindrico, 1,2 mm longo, 0,5 mm lato, ore paulo dilatato, receptaculo tenuissimo paululo exserto.

* * * * * * *

Nordöstl. Neu-Guinea: Kaiserin-Augusta-Fluss-(Sepik-) Gebiet: Hunsteinspitze, lichter Gebirgswald; dunkelgrüner Farn, einzeln im Moospolster. 1350 m ü M. (Ledermann n. 8493—22. Aug. 1912).

Zarteste kleine Art, kaum einer der bekannten Arten ähnelnd. Sie fällt auch durch ihr häufiges und unregelmässiges Proliferieren an den verschiedensten Stellen der Rachis und des Blattstieles auf.

5. MICROTRICHOMANES; THE GROUP OF TRICHOMANES DIGITATUM

Epiphytes, with finely filiform rhizomes and remote stipes; fronds dichotomous, rarely somewhat monopodial, the axes winged throughout, but the stipes not so, without false veinlets, or veins except the costæ of the segments, and without specialized margin, but often ciliate or setiferous; lamina dark in most species, commonly brownish, walls thin but likely to appear thick because seen with the contents of the cells closely applied to them; sori terminal on the longer segments, with usually obconic involucres, winged to the top; receptacle exserted but short.

A group of small and delicate epiphytes, ranging from the East African islands across Polynesia. The brownish color, the hairs of some species and the teeth of others, and the shape of the involucre (lips excluded), all suggest *Leptocionium* so strongly as to force a suspicion of affinity. Within *Trichomanes,*

certain species of *Hemiphlebium*, as *T. vitiense*, are quite surely reduced derivatives of *Microtrichomanes*. In the other direction, I am in doubt as to the affinity of this group and that of *T. pyxidiferum*. Any affinity to *Gonocormus* is still more doubtful. The chief desideratum, before any classification of the species here assembled can be accepted with confidence, is a knowledge of the stages in the development of young sporophytes. The group name, proposed by Mettenius, Über die Hymen. (1865), was used by Prantl, Hymen. (1875) 51, for a section of his genus *Gonocormus*.

Trichomanes digitatum and *T. nitidulum* are wide-spread species, the others comparatively local.

Key to the species.

Margin entire, without hairs or bristles.
- Lip entire.
  - Segments borne at an acute angle ..... 20. *T. nitidulum.*
  - Segments widely divergent, short ..... 21. *T. Francii.*
- Lip toothed ..... 18. *T. sibthorpioides.*

Margin bearing dark setæ, lip entire.
- Fronds irregularly monopodial, up to 10 cm long.... 25. *T. dichotomum.*
- Segments more uniform and fronds shorter.
  - Segments few, commonly 2 to 6..... 23. *T. digitatum.*
  - Segments many, commonly 10 to 30..... 26. *T. taeniatum.*

Margin and veins hairy, hairs simple, lip entire.
- Fronds as broad as long ..... 27. *T. palmatifidum.*
- Fronds elongate, segments few..... 28. *T. Ridleyi.*

Margin and lip toothed, ciliate with branched hairs..... 29. *T. Lyallii.*

18. TRICHOMANES SIBTHORPIOIDES Bory. Plate 8.

Trichomanes sibthorpioides BORY, in Willd., Spec. Plantarum 5 (1808) 498.

Hymenophyllum sibthorpioides METTENIUS, in Kuhn, Fil. Afric. 41.

T. frondibus reniformibus stipitatis palmato-incisis, laciniis linearibus obtusis emarginatis. W.

T. frondibus subpeltatis reniformibus crenatis pedatis dichotomis. *Bory in litt.*

Sibthorpienartiger Becherfarrn. W.

Habitat in nemoribus insulae Borboniae. ♃ (*v. s.*)

Caudex *filiformis crassitie setae equinae repens glaber.* Stipes *trilinearis filiformis glaber.* Frons *trilinearis reniformis, ultra medium palmato-incisa, tenuissime membranacea.* Laciniae *lineares integerrimae obtusae, majores emarginatae.* Sori *sub apice laciniarum.* W.—Bory and Willdenow, loc. cit.

This has been confused in synonymy with *T. parvulum*, and with what I suppose to be *T. digitatum*. I know it from a single specimen, *Hillebrand 3779*, received from Berlin as *H. sibthor-*

pioides Mett., which I feel justified in regarding as perfectly authentic. Sharing the characters of the two species just referred to, it is distinct from both. It has the texture and tendency to curl of *Gonocormus*, justifying the reference to *T. parvulum* as long as sterile fronds alone are known. The sori are rather those of *Microtrichomanes*, more particularly like those of *T. Lyallii* in shape and margin; but my specimen shows no trace of hairs, nor are there the dark cells which are at the bases of the hairs of *T. Lyallii* and *T. palmatifidum*, wherefore I believe the hairs really to be absent. Nevertheless, I believe that the nearest affinity is to this group.

Reports elsewhere than Madagascar are to be doubted.

19. **TRICHOMANES BARKLIANUM Baker.**

T. Barklianum BAKER, Journ. Linn. Soc. Bot. 9 (1867) 338, pl. 8, fig. F.

Frondibus stipitatis lineari-oblongis indivisis, venis pinnatim dispositis, venulis spuriis nullis, involucro solitario terminali, ore integro late alato.

Rhizome slender, creeping, copiously branched, matted with brown tomentum. Stipes one to two lines long, tomentose. Frond membranaceous in texture, not more than two or three lines long by one broad, in shape irregularly linear-oblong, the edge a distinct undulated line, more or less clearly ciliated, the blade furnished with a distinct midrib, from which proceed, at an angle of about 45°, to the margin, at nearly regular intervals, six to eight erecto-patent lateral veins on each side; intervenary spaces not reticulated; sori solitary, placed at the apex of the terminal vein, into which the base is narrowed gradually; the mouth broadly winged, but not two-lipped; the apex of the frond continuous with the wing on one side; the receptacle equal to the involucre or exserted. Discovered by Sir Henry Barkly, the Governor of Mauritius, and Lady Barkly, at the Tamari cascade in that island. This species and Hymenophyllum parvifolium, described below, are probably the most diminutive of known ferns, as it would take upwards of fifty fronds of average size to cover a square inch. This species and the next would probably be considered by Van den Bosch a distinct genus, differing from Microgonium by the absence of spurious venules.—Baker, loc. cit.

I have seen no specimen. Judging by description, affinity to *T. digitatum* seems probable.

20. **TRICHOMANES NITIDULUM van den Bosch. Plate 7, fig. 1.**

T. nitidulum VAN DEN BOSCH, Pl. Jungh. (1856) 547; Hymen. Javan. 21, pl. 15.

T. corticola BEDDOME, F. S. India 87, pl. 264.

T. inerme VAN DEN BOSCH, Meded. v.'s Rijks Herb. No. 17 (1913) 23, fig. 12.

Fronde glabra rubro-fusca e subcordato ovata vel rotundata longe stipitata digitata, laciniis fastigiatis latis linearibus simplicibus furcatisve, e cellulis firmis opacis mediocribus rubro-fuscis contexta, soris amplis late

marginatis, indusio infundibuliformi limbo leviter undulato, stipite capillari glabrescente fronde usque triplo longiore.

Hab. ad truncos putridos Javae; in m. Gedé et Salak (mixtum cum *Craspedoncuro pallido*), ZIPPELIUS in Herb. FRANQUEV.; in m. Pangerango alt. 6000 ped., v. GESKER, JUNGHUHN. Specie forsan non different specimina Ceylonica a THWAITES lecta (N. 3278).—Van den Bosch, Hymen. Javan., loc. cit.

Fronds 1 to 2 cm long and wide, on stipes as long or longer. The segments, 1 to 2 mm wide, may be as many as 10, and more or less equal; on less developed, commonly sterile fronds, they are fewer and often quite unequal, the frond tending to be monopodial. This difference in form between ill and amply developed fronds obtains throughout the group, and indicates that the broad, flabellate form is the derived (not primitive) one. The sorus is as wide as the top of the segment, as long as wide, the straight sides forming an acute angle at the base, the mouth undulate, not bilabiate. Described as glabrescent, it bears a few caducous hairs on the stipe and margin, but most specimens are perfectly glabrous; these hairs are weak, and relate *T. palmatifidum* to this species, rather than to *T. digitatum*.

I cannot see that *T. corticola*, whether from Ceylon (*Beckett, Ferguson*) or from New South Wales (in Herb. Singapore ex Herb. Sydney as *T. digitatum*), is in any respect distinct. Between these geographical extremes, I have it from Java, Sumatra (*Bartlett 7989*), and Tonkin (*Pételot 4441*). It has been reported from Riau, Borneo, and the Philippines, in error at least as to the last.

21. TRICHOMANES FRANCII Christ. Plate 7, fig. 2.

Trichomanes Francii CHRIST, Bull. Herb. Boissier II 7 (1907) 648.
T. cuneatum CHRIST, Bull. Herb. Boissier II 7 (1907) 649.

. . . typus in herb. Bonati.

Du groupe goniocormus V. S. B., très distinct par un tissu rigide, glabre, vert et non tournant au brun. Fronde orbiculaire-flabellée, à lobes irréguliers, très courts, larges et peu profonds, le gros centre de la fronde restant indivis. Urcéoles largement triangulaires-campanulées, entièrement immergées dans le bord du lobe.

* * * * * * *

Rhizomate tenui fere filiformi brunneo rigido nitente repente ramoso intertexto, foliis sparsis sus approximatis, stipite 1 ad 1½ cent. longo brunneo filiformi sed rigido curvato nudo, uti tota planta, lamina suborbiculata basi truncata sive cuneata 6 mill. longa 8 mill. lata, breviter flabellatim lobata, lobis irregularibus circa 5,2 mill. longis et latis integris, sterilibus rotundato-obtusis, fertilibus decussatis, linea incrassata marginatis. Costa nulla. Nervis atrobrunneis partim dichotomis partim sim-

plicibus, in lobis singulis, ante marginem incrassatis, versus marginem saepe suboccultis, venulis spuriis paucis, inconspicuis.

Urceolis viridibus 2 aut 3, in apice abcisso loborum singulis, late campanulato-triangularibus, magnis, 1½ mill. longis et latis, omnino immersis, ore recte abscisso nec labiato, margine integro, receptaculo soroque profunde immerso.

Textura crassiuscula sicce rigida, subdiaphana, colore laete virente.

Hab. Forêts humides du Mont Mou [New Caledonia] 1200 m. Très rare. F. 1906 n. 163, l. Franc.—Christ, loc. cit.

Trichomanes cuneatum, based on *Franc 165*, the type also said to be in the Bonati herbarium, was collected in the same place, and supposed to be distinguished by being somewhat larger, more deeply divided, and more delicate. The Bonati herbarium as bought by the California Botanic Garden contained no specimen of *165*. It contains *163* collected in December, 1906; very copious material bearing the same number, collected in 1910; specimens without number collected in the same place in 1907; and *828* and *2004*, which are similar but without data of collection. The 1910 collection completely blankets the descriptions of Christ's two species, growing mixed, and certainly all one plant. The margin is slightly differentiated, not thickened and without a marginal vein. And the fronds of all of the collections have turned brown with time.

It is an exceptionally distinct species.

22. TRICHOMANES VITIENSE Baker. Plate 9, figs. 1 and 2.

Trichomanes vitiense BAKER, Journ. Linn. Soc. Bot. 9 (1866) 338, pl. 8, D.

T. Powellii BAKER, Syn. Fil. (1867) 76.

Frondibus substipitatis oblongis integris vel bifidis costa centrali sola, venis lateralibus et venulis spuriis nullis, involucro solitario terminali incluso, ore integro subdilatato.

Forming close densely matted patches. Rhizome slender, wide-creeping, branched, tomentose. Stipes one to three lines long, sometimes absent. Fronds linear-oblong or oblong, usually undivided, occasionally emarginate or bifid, quite entire at the margin, furnished with a distinct midrib, but without either lateral veins or spurious venules; involucre urceolate-cylindrical, solitary, terminal, quite sunk in the frond, the slightly dilated entire mouth equalling the margin.

Fiji, *Milne*.—Baker, loc. cit.

Reported as common in Queensland and cited from Fiji, Samoa, and New South Wales, by Domin, Bibl. Bot. 20: 10, pl. 3, f. 3. Compared with *T. Motleyi* and *T. Sayeri*, Domin's figures indicate more slender fronds than Baker's, and make this and the presence of stipes the distinctions from *T. Motleyi*.

I have no specimen from Fiji, but have no reason to doubt the identity of those from New South Wales represented by Plate 9, figs. 1 and 2. The fronds are about 2 mm wide and up to 8 mm long, on stipes less than 1 mm long and, like the rhizome, notably slender. The cell walls are very thin, and hyaline. Against all lateral walls, except the marginal ones, is collected the dense contents of the cells, with the result that with low magnification the walls appear notably thick. The mouth of the involucre is hardly dilated, but the whole upper part of it is overfull and therefore folded in pressed specimens.

The absence of any veins except the costa makes this species very distinct from any other known.

While it would not be suspected from Baker's description, and I have not seen an authentic specimen, I believe that *T. Powellii* Baker is a better developed form of the same species named, in its most simple form, *T. vitiense*. The close affinity was recognized by Kuhn, Linnaea 35 (1868) 387; and the *T. vitiense* cited from Samoa by Domin must be this plant. Kuhn tried to distinguish the Samoan from the Fiji plant by the fact that the fronds are *sometimes* divided, and by thinner cell walls and a cyathiform involucre. The walls of the Australian plant are remarkably thin; Domin depicts the involucre of *T. Powellii*, and illustrates the fronds as usually simple, but sometimes forked.

TRICHOMANES ASWIJKII (sphalm. ASNYKII) Raciborski, Natuurk. Tijdg. Ned. Ind. 59 (1900) 238, pl. 2, fig. 6.

Rhizome an der Baumrinde kriechend, kurz beharrt, in Abständen von 5–12 mM. Blätter tragend, reich verzweigt, ausgedehnte, reine Rasen bildend. Blattstiel fadenförmig dünn, 1–4 mM. lang. Blattlamina bald ungetheilt, bald dichotom 1–2 mal gegabelt, glatt, ohne Scheinnerven, ganzrandig, gelbgrün, nach dem Trochnen tabakbraun. Ungetheilte Blätter linear, 2.5–5 gewöhnlich 4 mM. breit, mit einem starken Mittelnerven, an der Spitze, wenn steril ausgerandet, gegen die Basis verschmälert. Häufig kommon einmal bis zur Hälfte der Länge der Lamina oder etwas tiefer gegabelte Blätter, seltener sind noch einmal gegabelt, so dass ein Blatt in 2, 3, 4 oder sogar 5 breite Lacinien ausläuft. Die Sori apical, cylindrisch trichterförmig, eingesenkt in der Blattspitze, 3 mM. lang, mit einer breiten, runden, oder schwach zweilappigen ganzrandigen Rand des Indusiums. Receptaculum bis 8 mM. lang. An den Baumstämmen am Fuss des *Slamat*, 1200 M. hoch zusammen mit *T. sublimbatum;* sehr häufig am *Goenoeng Bintjana*.—Raciborski, loc. cit.

Except it be somewhat broader fronds or segments (4 mm as against 2 or 3 mm), there is nothing in this description to distinguish the plant from *T. vitiense;* and the discovery in Java of a plant so likely to be overlooked in the Papuan region would

not be surprising. I do not try to place the species, without seeing a specimen, however, because it must also bear a notable likeness to a reduced form of *T. nitidulum*, its neighbor in Java. Also, only the absence of rather inconspicuous false veinlets distinguishes it from the same author's *T. rupicolum*. The illustration does not show that the tube of the involucre is at all cylindric.

23. TRICHOMANES DIGITATUM Swartz. Plate 7, figs. 3 and 4.

T. digitatum SWARTZ, Syn. Fil. (1806) 370.
T. lanceum BORY ex Willd. Spec. Pl. 5: 500; HOOKER and GREVILLE, Ic. Fil. pl. 33.
T. flabellatum VAN DEN BOSCH, Hymen. Javan. 19, pl. 13.
T. Blumei HASSKARL, Observ. Bot. Fil. 2: 4.

Habitat in Ins. Franciae et Borboniae.

Descriptio

Surculi implexi, capillares, flexuosi radiculis brevissimis villosis hinc inde exsertis, reptantes.

Frondes stipitibus capillaribus semipollicaribus laxis suffultae, erectae, diaphanae, recticulatae laete virentes, digitatae (circumscriptione ovato-subrotunda); *laciniis* profunde ab invicem separatis, linearibus, erectis, subuncialibus, latitudine 2 lin., plerumque indivisae l. interdum bipartitae, apicibus obtusis subemarginatis, margine subdenticulatis, denticulis setis brevissimis adpressis terminatis.

Urceoli solitarii sub apicibus laciniarum inserti, *ore* dilatato integerrimo.

Observatio

Distinctissimum fronde digitata, urceolis insertis ore dilatato subcampanulato.—Swartz, loc. cit.

On page 422 is a more concise diagnosis, including: "laciniis . . . indivisis bipartitisve."

This is an excellent description of the species in its type locality, except only that the brownish cast characteristic of the group is not wanting here; the segments are always few, commonly 2 to 4. Exactly similar specimens can be found wherever the species occurs, but more ample ones are commoner in fruit in most such places. *Trichomanes flabellatum* van den Bosch was to be distinguished chiefly by more numerous segments, the less divided fronds in his fig. 1 being sterile; but fronds with very few segments may also be fertile, at least in most places.

Aside from the two forms just mentioned, several others are locally recognizable. It is common in the Peninsula, and not rare in the Philippines and Java, for some of the segments to be arrested in their development, while their twin segments elongate and fork again, thus producing an irregular monopodium, or a frond with several branches somewhat monopodial

in development. There is every gradation to these moderately elongate fronds and those equally long and wide. This tendency to elongate is exaggerated in a strain in western Java, resulting in fronds sometimes more than 10 cm long, which it has been convenient to distinguish specifically, as *T. dichotomum.*

A form with broad, and correspondingly few, segments, up to 3 mm in width, is occasional in the Philippines: *Bur. Sci. 9791 Robinson,* from Mount Banahao, Plate 7, fig. 4; *Bur. Sci. 37748 Ramos and Edaño,* from Bontoc. While the individual collections of this are fairly uniform, other collections fill the gap, down to those with segments at most 1.5 mm wide. In the southern Philippines, there seems to be a fixed small form: *Elmer 14125a;* but the typical form and the elongate form are also there.

Mauritius, Java, Borneo, the Peninsula and Singapore, the Philippines; apparently, also, Samoa, whence all specimens I have seen are too imperfect for certainty. Reported in many other places; but as I have seen almost every species in the group labelled *T. digitatum,* I abstain from citation by report.

24. TRICHOMANES LIBERIENSE Copeland sp. nov. Plate 9, figs. 3 to 6.

T. minutum, rhizomate filiforme ramoso intricato velutino; stipite ca. 1 mm longo; fronde plerumque ca. 6 mm longa, 3 mm lata, elliptica vel obovata, basi rotundata vel rarius cordata v. subcuneata, apice rotundata, integra vel crenulata, costata, venis utroque latere costae 5–7 simplicibus, venulis spuriis nullis, margine setis nigris nonnullis simplicibus vel binatis ornata; soro terminale, tubo cylindrico immerso, ore valde expanso exserto et libero.

Liberia, Mount Coffee, *O. F. Cook,* March, 1894. Type in *U. S. Nat. Herb. 424785.*

Very clearly distinguished by the absence of false veins and the presence of marginal hairs from all species except *T. barklianum.* From that species, known from the islands on the other side of Africa, it seems to differ in being narrower and more nearly sessile, and with a more expanded lip.

25. TRICHOMANES DICHOTOMUM Kunze. Plate 7, fig. 5.

Trichomanes dichotomum KUNZE, Bot. Zeit. 6 (1848) 285; VAN DEN BOSCH, Hymen. Javan. 22, pl. 16.

Frondo membranacea, laxa, oblonga, obtusa, flexuosa, margine setulosa (fusco-olivacea), basi in stipite decurrente, pinnata; pinnis in rhachi alata decurrentibus, furcatis dichotomisve, angulis obtusiusculis, segmentis uninervibus, lineari-oblongis, apice sorophoris, sterilibus obtusis emarginatisve;

involucris scyphiformibus, immersis, labiis liberis, rotundatis, repandis, nudis; receptaculo filiformi, emerso; stipite brevi, setaceo-filiformi, parce et minute paleaceo; caudice repente, filiformi, sparsim frondigero et radiculoso, in basi stipitum et radicularum densius rufo-paleaceo. (*Hymenophyllum* n. sp. Mor Verz.)

. . . Ex affinitate proxima *Trich. digitati* Sw. et *translucentis* mihi (l. l. p. 302) sed ambitu, textura minute oblongo-cellulosa pellucida, parietibus incrassatis fuscis, colore fusco-olivaceo ab utroque diversum. Frondes ad 5″ longae, vix 4–6‴ latae; valde flexuosae. Stipes 2–3 pollicaris, gracillimus. Statio haud dubie ad truncos, cum muscis, hepaticisque mixtum occurrit.

Java. *Zollinger 1707.*—Kunze, loc. cit.

The frond is not pinnate, but monopodial. A single main axis may develop, as described by Kunze, producing a very narrow frond; more commonly, one to several other axes also develop similarly, thus producing a variety of irregular frond forms. The same tendency of growth responsible for the elongate frond results in involucres longer than in typical *T. digitatum.*

As described by Kunze, figured by van den Bosch, and illustrated by a collection by Raciborski on Mount Salak in 1897, this seems very distinct from *T. digitatum.* However, a collection from the same region by *Bakh. v. d. Brink 2612,* "Goenoeng Jjisalak," distributed as *T. dichotomum,* is about as near to one as to the other. The tendency to this manner of growth in *T. digitatum* has been mentioned in the discussion of that species.

26. TRICHOMANES TAENIATUM Copeland. Plate 10.

Trichomanes taeniatum COPELAND in Bishop Mus. Bull. 93 (1932) 6, pl. 2.

T. dichotomo-digitatum, rhizomate gracillimo, vix 0.15 mm crasso, stipiteque simile 2 ad 3 cm longo nigris pilis paucis debilibus caducis vestitis; fronde pendente flabelliforme, 2 ad 3 cm longa et lata, pluries dichotoma segmentis 15 ad 45, sursum 1.5 ad 2 mm latis deorsum angustatis, integris vel rarius undulatis, setis nigris appressis ciliatis aliter glabris; involucris aut campanulatis aut brevi-tubulatis, ore integro late expanso, in herbario bilabiato.

Tahiti, *Grant 3561* (type), Fautaua, below Diadem, altitude 970 m; Teahupoo, *Grant 3881,* altitude 450 m, on *Cyathea; Grant 4401,* Mahina, altitude 1,070 m; *Vesco.* Borabora, *Grant 4981,* Tarapaia.

The material is not uniform. The type collection and *Grant 3881* are bright green, with narrow segments and tubular involucre. The Mahina collection has broader and less numerous

segments, is dark and turns darker, and has a campanulate involucre. I would be disposed to regard them as specifically distinct, but that the Borabora collection is between them, with broad segments but tubular involucre.

27. TRICHOMANES PALMATIFIDUM C. Müller. Plate 7, fig. 6; Plate 11, fig. 1.

Trichomanes palmatifidum C. MÜLLER, Bot. Zeit. 12 (1854) 732; VAN DEN BOSCH, Hymen. Javan. 20, pl. 14.

Cespitulosum parvulum tenellum; rhizoma repens intricatum capillare, pilis fuscis simplicibus subulatis acutis teneris hirsutulum; frons in stipite capillari *elongato* piloso *perfecte digitata, e pinnulis* 4–6 *dichotomis subaequilongis composita;* pinnulae *breves* ligulato-lineales angustae obtusatae tenerae, *margine et nervo ciliatae,* fusco-virentes, nervis capillaribus percursae; cilia *subito e folio enata subulato-filiformia longa duplicata;* cellulae pellucidiores fuscidulae ampliores hexagono-parenchymaticae teneriores; indusia in pinnulis omnibus terminalia minuta oblonga *ciliato-hirsuta.*

Tr. digitatum Blume. Enum. Filic. Javae, p. 224. excl. syn. Swartz.-Hook. Sp. Filic. I. p. 119. species Javanica.—Kunze, Recens, Hymenophyll. Hookeri. Bot. Zeit. 1847. p. 302.

Patria. Java, in muscosis truncis arborum: Blume. Zollinger Coll. No. 1722.

A praecedente (T. digitatum) signis cursive impressis certe distinguitur et pulcherrima species.—Müller, loc. cit.

Well characterized by long stipes, hairy fronds, and short sori; the sides of the involucre commonly meet at the base at an obtuse angle, so that the sorus is broader than long. The hairs are exceedingly slender, and therefore readily broken off. Judging by the considerable number of collections seen, this species is more uniformly digitate, with fronds about as wide as long, than is *T. digitatum;* which makes the comparatively elongate frond of the succeeding species quite distinct.

Java, Sumatra, the Peninsula. So little known beyond Java that it is worth while to cite collections: Sumatra, *Winkler 111.* Pahang, *Ridley, Eryl Smith 883, Md. Haniff and Nur 7879, Holtthum 20640.* Kelantan, *Md. Nur 12202.* Perak, *Scortechini.* All Peninsular collections in the Singapore herbarium.

28. TRICHOMANES RIDLEYI Copeland sp. nov. Plate 11, figs. 2 and 3.

Microtrichomanes, rhizomate stipitibusque angustissime filiformibus, stipitibus 3 ad 5 cm altis; fronde 2 ad 2.5 cm longa, dichotome ramosa segmentis paucis adscendentibus atroviridibus vix ultra 1 mm latis, margine et sparsius costis pilis ferrugineis 0.5 mm longis deciduis ciliatis; soro late obconico, vix 1 mm lato et saepius quam lato breviore, labiis late rotundatis ciliatis.

Malay Peninsula, Pahang, Gunung Talian, *H. N. Ridley 15909,* July, 1911. Type in Singapore Herbarium.

The pubescence is that of *T. palmatifidum;* the gross appearance rather that of *T. digitatum;* the stipes are too long for either, and the sori too short for *T. digitatum.*

29. TRICHOMANES LYALLII Hooker. Plate 7, fig. 7; Plate 11, fig. 4.

Trichomanes Lyallii HOOKER, Syn. Fil. (1867) 77.
Hymenophyllum Lyallii HOOKER, f., Flora Nov.-Zel. 11 (1854) 16.
T. calvescens VAN DEN BOSCH, Ned. Kr. Arch. 5 [2] (1863) 199.

St. 1–2 in l., slender, filiform; *fr.* ¾–2 in. each way, suborbicular in general outline, flabellately divided down very nearly to the base into dichotomously-branched narrowly linear ciliated and minutely denticulate segments; *sori* 3 or 4, terminal on the segments; *invol.* obconical, quite sunk in the tube, the mouth ciliated, not dilated. . . .

Hab. Trees, south-west coast of the middle island, New Zealand, *Dr. Lyall.*—Hooker, Syn. Fil.

The most distinct species in the group, characterized by peculiarly toothed margins of frond and involucre. Each tooth bears a hair, consisting of a long basal cell surmounted by 1 to 3 (most often, 3) widely divergent or radiate more slender cells, these branches of the hair sometimes two cells in length. · A common size of frond is 2 cm in length and breadth.

Trichomanes calvescens is absolutely identical, except, judging by the few specimens seen, for being somewhat smaller.

New Zealand and New South Wales.

This is not merely congeneric with *Hymenophyllum obtusum;* it is hardly more than a reduced form of that species, which, in small but still fertile forms, becomes more flabellate than pinnate. I am not questioning the generic position of *H. obtusum,* nor the affinity of *T. Lyallii* and *T. palmatifidum;* but am leaving *Microtrichomanes* in *Trichomanes,* until the question of generic boundaries may be studied as a whole. Compare Fournier, Ann. Sci. Nat. V 19 (1874) 292.

6. CREPIDIUM PRESL, HYMENOPHYLLACEAE, PAGE 115, AS SECTION OF DIDYMOGLOSSUM; AS GENUS, EPIMELIAE PAGE 258; NON BLUME.

Small ferns, usually notably thin, without veins, but with one or two rows of specialized, elongate, more or less thickened, marginal cells, of which the inner row (or both) may be two cells deep. Axes usually winged throughout. Sori winged, with dilated but hardly lobed mouth, occupying the first acropetal secondary segments; that is, axillary in distinction to terminal. A natural group of a few species, confined to the Malay-Polynesian area; related to the group of *T. pyxidiferum,* but without evident affinity to *Taschneria.*

Key to the species of Crepidium.

Marginal elongate cells a single row.
Ultimate segments elongate.
Segments narrowly cuneate ..... 32. *T. endlicherianum.*
Segments linear, sides parallel ..... 33. *T. Werneri.*
Segments mostly short and toothlike..... 34. *T. Vieillardii.*
Marginal elongate cells in a double row.
Rachis and involucre conspicuously winged..... 30. *T. humile.*
Rachis and involucre narrowly winged..... 31. *T. gracillimum.*

Doubtful species of this section are *T. perpusillum* v. A. van Rosenburgh, *T. apicilare* Fournier, *T. assimile* Mettenius, and *T. paniculatum* v. A. van Rosenburgh.

30. TRICHOMANES HUMILE Forster. Plate 12.

Trichomanes humile FORSTER, Prodromus (1786) 84.
T. luzonicum PRESL, Hymenophyllaceae (108 nomen) 134.
T. concinnum METTENIUS, Linnaea 35 (1868) 385.
T. filiculoides CHRIST, in Schum. and Laut., Fl. Deut. Schutzgeb. (1901) 108.
T. Lauterbachii CHRIST, in Schum. and Laut., Fl. Deut. Schutzgeb. (1901) 108.

Frondibus pinnatifidis dichotomis: pinnis alternis decurrentibus linearibus obtusis integris, fructificationibus turbinato-infundibuliformibus, stylis setaceis exsertis, stipite vix ullo. F.

Societatis insulae.—Forster, loc. cit.

Rhizome creeping and interlaced, very slender, velvety. Stipe almost none, or a centimeter or more long and winged in the upper part. Frond 2 to 8 cm long, ovate if short, lanceolate or ovate-lanceolate if elongate, usually bipinnatifid, the axes winged throughout and bearing short, scattered, caducous hairs. The segments are rather remote; those immediately below the apex, and usually the basal ones, are short and simple, the medial ones forked or pinnatifid; on very ample fronds, some acroscopic secondary segments are again forked. The ultimate segments are commonly about 1 mm wide, sometimes not more than 0.6 mm; with its wing, the axis may be as wide as the segments, or distinctly narrower. The apex of a segment is usually indented, with an interruption of the marginal line, but may be rounded, with the line continuous around it. The color is usually a pale green, but varies to dark.

The most distinctive character of the species is a double row of marginal cells (as seen in surface view), elongate parallel to the margin, two to four times as long as wide, with cross walls running obliquely downward and inward from the margin. The outer wall is hyaline, with slightly thickened walls. The inner

row is thicker-walled and therefore darker, and peculiarly marked, usually by a longitudinal row of little circles, as shown by Plate 12, figs. 1 and 2. Mettenius, Hymenophyllaceae, pl. 1, figs. 28 and 29, figured this pattern, and showed that it is produced by hemispherical thickenings of the inner walls of both of two superimposed cells, this single line of the frond being two cells thick. Exceptionally, the pattern varies, the thickened spots being enlarged until the thin spaces between them present a reticulate appearance. More rarely, no pattern is visible.

As in very many species, single cells or groups of cells, presumably diseased or dead, become dark or black. In *T. humile,* this is most likely to befall the elongate marginal cells; if it happens to very many of them, the result is a black marginal line, obviously not a specific character in such cases. Fronds so bordered are common on Mount Maquiling, Luzon, as illustrated by *Copeland 2145* and *Bur. Sci. 9888 Robinson;* but occur elsewhere, as on *Grant 4941,* from Borabora, and *Grant 5297,* from Huahine.

The sori occupy the first acropetal branches of the fertile primary segments, standing parallel to the axis of the frond, remote both from this axis and from the next acropetal segment, if there be another. Rarely, on the most ample fronds, the largest primary segments (pinnæ) are sparingly bipinnatifid, and a sorus may then stand parallel to the axis of the primary segment; this is rather characteristic of Singapore specimens.

The involucre is tubular, or slightly widened upward, about 2 mm long, with a wing usually three to six cells wide, sometimes narrower, sometimes dilated at the base. The mouth is abruptly dilated; sometimes moderately, so as hardly to exceed the diameter of the tube plus its wings, sometimes considerably farther. The sclerenchyma strands running up the sides of the tube also bend abruptly outward at the mouth, but do not usually reach the margin. In end view, the mouth of fresh specimens is usually orbicular; at most, the diameter vertical to the plane of the frond is slightly the greater. A mouth so dilated is necessarily flattened and folded in pressed specimens, presenting more or less the aspect of being two-lipped. Thus Plate 85, fig. 1, of Hooker and Greville reasonably illustrates a pressed specimen; but fig. 5, purporting to represent a sorus with the near side of the involucre removed, is, as to the mouth, a figment of the imagination. Although it typifies Presl's section *Crepidium* of *Didymoglossum,* it is not at all a *Didymoglossum* in Presl's sense. Neither does it typify the same author's *Crepidomanes,* later

published as a genus, nor can it properly belong in such a genus, typified by *T. intramarginale.*

The receptacle is remarkably slender, and therefore very commonly broken. It may be two or three times the length of the involucre.

The type locality as stated by Forster is the Society Islands. After satisfying myself that *T. endlicherianum* is a distinct species, and that *T. tenue,* described from Tahiti, is like *T. endlicherianum,* it became important to know *T. humile* from the group as thoroughly as possible. Fortunately, Mr. M. L. Grant was collecting there, and brought in ample collections from Moorea, Borabora, and Huahine, as well as from several places on Tahiti. In all of these collections, as well as in the considerable number of others in hand from Tahiti, the double row of marginal cells is constant. Within the archipelago, the species is well defined, varying to but within the limits indicated in the foregoing description; as a general rule, it is rather small here, fronds more than 5 cm tall being above the average.

It is common also, and identical, in Samoa, Fiji, and Rarotonga. I have it also from the Carolines[7] (probably *T. depauperatum* Bory[8]), Papua, Amboina, Java, and Sumatra. My Hawaiian specimens received as *T. humile* are *T. draytonianum,* while those from New Zealand are *T. endlicherianum.* In Singapore and the Malay States, a more ample form, with rather narrow segments, is common. Both this and the typical form occur in Borneo, as well as one with very slender fronds. In the Philippines it is a very common species, in the typical form, and in one somewhat taller, but not wider, and without the peculiarly placed sori found in Singapore. Philippine collections distributed under other names are *Cuming 98,* the type of *T. luzonicum; Merrill 6064* and *6065; Clemens 226; Elmer 7077; Bur. Sci. 13302, 14956, 22517, 28080, 30843, 31473, 41534.* Others apparently distributed unnamed are *Merrill 6309* and *Bur. Sci. 12082.*

Trichomanes luzonicum Presl is perfectly typical *T. humile,* described under the illusion that *T. humile* was a *Didymoglossum. Trichomanes filiculoides* was published with the citations *"Lauterbach 535c, 541 . . . 988."* The first of these, which should be the type, was apparently segregated from a mixture;

[7] *Volkens 364,* in the Singapore Herbarium as *T. rigidum,* is *T. humile.*
[8] Cf. van den Bosch, Hym. Jav. 16 and 17.

I have not seen it. No. *541* is in the University of California and Singapore herbaria, and *988* in the Singapore herbarium, and both are typical *T. humile*. It was described again in this instance as a *Didymoglossum*, and contrasted with *T. Filicula*, which indeed it does not resemble.

Trichomanes Lauterbachii Christ, published on the same page as *T. filiculoides*, as *Crepidomanes* "ex affinitate *T. pyxidiferi*," ought by description to be a small *T. humile* with exceptionally broad fronds, typified by *Lauterbach 2825a*. I have not seen this collection; but in the herbarium of the University of California are *Schlechter 16182, 17307*, and *19072*, all received as *T. Lauterbachii*. As a whole, they conform to the description, and can be taken as correctly named; but all of them contain, along with the broader fronds, and on the same rhizomes, fronds of the typical form of *T. humile*. At most, it is a small and not well-established local form.

Trichomanes concinnum Mettenius was described from Tahiti, based on collections by Vieillard and Vesco. A Vesco specimen in the Bureau of Science herbarium is *T. humile*. As this collection is not numbered, it may or may not have been the same seen by Mettenius. Mettenius is the last author whose species in this group I would be disposed to question. However, the actual publication was after his death, and the extensive posthumous publication of his notes is responsible for no few names which so careful a student might have preferred to leave in manuscript. While he does not mention *T. humile*, a little *Trichomanes* with "series binae cellularum marginalium manifestius incrassatæ" must be that or a very nearly related species. I construe it as a very small and correspondingly little dissected, perhaps juvenile, form of *T. humile*. It is represented also by *Grant 3679*, which is surely a juvenile *T. humile*.

To *T. humile* have been reduced also *T. minutulum* Gaud., from Rawak, and *T. aureum* van den Bosch, both unknown to me save by description. The former was figured, Freycinet, Voyage, etc., pl. 12, fig. 2, as having the mouth two-lipped in a degree never simulated by any pressed *T. humile*, and its description stresses this feature. As the reduction was made by Hooker, Sp. Fil. 1: 124, who thought *T. humile* had a two-lipped involucre, I mistrust it; the reduction to *T. filicula* Desv. by van den Bosch, Synopsis 41, is more reasonable. *Trichomanes aureum* was described from New Zealand, and is more likely to be *T. endlicherianum*, if either.

81. TRICHOMANES GRACILLIMUM Copeland sp. nov. Plate 13.

Crepidium, rhachi et involucro angustius alatis, soris pinnarum majorum saepius pluribus, serie interiore cellularum marginalium male distincta, aliter T. humili simile.

LUZON, Ilocos Norte Province, Mount Palimlim, *Bur. Sci. 33383 Ramos* (type in Bureau of Science herbarium), August, 1918: Kalinga Subprovince, Mount Masiñgit, *Bur. Sci. 37576 Ramos and Edaño.*

A local derivative of *T. humile*, of quite distinct appearance because of the extreme narrowness of the wing on the main rachis, the bases of the secondary rachises, and the involucres. While it is effectively invisible to the naked eye, the microscope shows that this wing, two or three cells wide, persists well down onto the stipe. The ultimate segments are narrower than is usual on *T. humile*, but the peculiar appearance is due to the failure of the laminar wing to hold what width it has, as it runs down to the major axes. The tendency of sori to appear elsewhere than parallel to the main rachis is more emphasized than in the Singapore plant noted in the discussion of *T. humile*. The Mount Masiñgit specimen is less distinct from *T. humile* than is the type, as to the wing, but more so as to the lack of differentiation of the inner row of marginal cells.

82. TRICHOMANES ENDLICHERIANUM Presl. Plates 14 and 15.

Trichomanes Endlicherianum PRESL, Epim. Bot. (1849) 10, pl. 5. A.
T. erectum BRACK., U. S. Expl. Exped. 16 (1854) 250, pl. 36, fig. 1.
T. tenue BRACK., U. S. Expl. Exped. 16 (1854) 251, pl. 36, fig. 2.
T. Naumannii KUHN and LUERSSEN ex Christ, Engler's Bot. Jahrb. 23 (1896) 336.
T. alternans CARR., Flora Vitiensis (1873) 343.

T. (Eutrichomanes, pinnata) glaberrimum, fronde anguste lanceolata bipinnata, pinnulis lateralibus ovato-lanceolatis acutiusculis adnatis, terminalibus pinnisque superioribus apice acutiuscule bidentatis (rarius integris), rachibus late alatis, stipite (brevi) apice alato, soris subaxillaribus late alatis immersis, indusio infundibuliformi-campanulato, limbo patente, receptaculo setaceo elongato.—T. humile Endl. prod. fl. norf. 17 (excl. syn.).

Habitat in insula Norfolk (Ferdinand Bauer).

Differt a Didymoglosso humili (Trichomanes humile Forst. prod. 464) et a D. minutulo (Trichomanes (Didymoglossum) minutulum Gaudich. in Freyc. voy. 377 t. 12. f. 2) limbo indusii truncato-hypocraterimorpho nec bilabiato et inde genere. Quodsi in Aspidiaceis, Aspleniaceis aliisque Filicibus indusiatis ratio indusii ad genera distinguenda valet et sufficit, quoque in Hymenophyllaceis valere et sufficere debet. Mirum est, quod Endlicher, qui genuinum Trichomanes humile Forst. in Hook. et Grev. ic. fil. t. 85 optime delineatum vidit, specimina Baueriana non diversa esse credidit. Idem valet de Didymoglosso minutulo. Accedit quoque ad T. intramargi-

nale, sed differt absentia venulae inframarginalis, cellulis laciniisque frondis, indusio.—Presl, loc. cit.

I have seen no Bauer specimen, but have from the National Herbarium of New South Wales a collection made on Norfolk by Metcalfe in 1905, which I believe to be typical as well as topotypic. If this is correct, Presl's distinction, specific or generic, in form of mouth of involucre, does not exist. Nevertheless, the species is distinct from *T. humile,* characterized most clearly by having a single instead of a double row of elongate marginal cells. The primary segments stand at an acute angle to the main axis, making the frond narrower in general outline, in spite of the fact that its segments of every order are characteristically longer. The ultimate segments commonly widen slightly from the base to the apex, while the sides of those of *T. humile* are normally parallel. The wing of the involucre is broader, so that the mouth, as dilated (and as abruptly dilated) in proportion to the tube as in *T. humile,* does not project beyond the wing, at any rate as conspicuously as in *T. humile.* The receptacle, apparently less fragile, is even longer, three or four times the length of the tube when fully developed.

The marginal cells are commonly more elongate than in *T. humile,* even up to eight times their width. Their walls may be uniformly thickened, as described and figured by Mettenius, Hymenophyllaceae 406, pl. 1, fig. 30; but more commonly the outer wall is the thicker, especially near the junction with the very oblique cross walls.

The species which I have reduced to synonymy with *T. endlicherianum* were probably all described in ignorance of that species as distinct from *T. humile.* Van den Bosch, Journ. Bot. Néerl. 1 (1861) 350, recognized the affinity of both of Brackenridge's species to *T. endlicherianum,* but regarded them as distinguishable from it. To me, *T. tenue* looks like no more than a narrow form, with some corresponding modification in size of cells. *Trichomanes erectum* is not quite so clear a case. However, I find no structural distinctions, and those in form are reasonably associated with its reduction in size. Van den Bosch suspected it of being a small form of *T. tenue,* and so it seems to me. It is wanting in our extensive recent Fiji collections, the specimens I so determined, *Parks 20480,* Bishop Museum Bull. 59: 24, being *T. humile. Trichomanes tenue* is likewise wanting in our many recent Tahiti collections. Of both of these "species," I have in hand the types from the United States National

Herbarium, and cotypes from the Gray Herbarium. Their absence in recent collections is very surprising.

Trichomanes Naumannii is represented by a cotype in the United States National Herbarium. It was ill described, but the specimen is perfectly identical with that of *T. tenue*.

I have not seen authentic *T. alternans*. It was distinguished from *T. erectum* by the form (elongato-linearibus) and direction (erectis) of the segments and the obvious hyaline margin. As these are all characteristics of *T. erectum*, they cannot serve to distinguish another species from it.

The known range of the species is from the South Island of New Zealand to Norfolk, Fiji, Samoa, and Tahiti. I have already noted that specimens from New Zealand distributed as *T. humile* are all (as far as I have them) *T. endlicherianum*. They are commonly smaller than typical plants or typical *T. tenue*. I suppose that they represent *T. aureum* van den Bosch, Ned. Kruid. Arch. (1863) 208.

33. TRICHOMANES WERNERI Rosenstock. **Plate 16.**

Trichomanes Werneri ROSENSTOCK, Fedde's Repert. 5 (1908) 35.

Eutrichomanes; rhizomate longe repente, filiformi, breviter tomentoso; stipitibus 0,5-centimetralibus, tenuibus, usque ad imam fere basin alatis; laminis ovalibus, usque ad 3 cm longis, 2 cm latis bipinnatifidis; segmentis primariis fere 7-jugis, medialibus maximis circiter 12 mm longis, 5 mm latis, rhomboideo-lanceolatis, inferioribus plus minus decrescentibus; segmentis secundariis inferioribus pinnatifidis, reliquis furcatis seu simplicibus; laciniis linearibus 0,4–0,5 mm latis, simplicibus vel basalibus furcatis, apice emarginatis, margine cellulis diaphanis, linearibus, uniseriatis cincto; rhachibus costique angustissime alatis; venulis tenuibus, prope marginem desinentibus; soris immersis, infundibuliformibus, ore dilatato, undulato; receptaculo flexuoso, longissime exserto, quam indusium 12–15-uplo longiore (2,5-3 cm longo).

Nova Guinea: In monte Gelu, ad saxa, prope 'stationem' c. 1000 m alt.—leg. Dr. E. Werner VII, 1907, No. 27.

Habituell und in der Zellstruktur (vgl. den hellen Randstreifen) mit *Trichomanes humile* Forst, verwandt, unterscheidet sich *T. Werneri* von diesem durch etwa halb so breite Segmentzipfel (hier 6–7, dort ungefähr 12 Zellreihen auf der halben Breite der Lacinie) und durch das überaus lange Rezeptakulum, das bei *T. humile* die Länge des Indusium nur um das 1½ fache übertrifft.—Rosenstock, loc. cit.

The very immediate affinity of this fern is not to *T. humile*, but to *T. endlicherianum*, with which, as a species distinguishable from *T. humile*, Rosenstock seems not to have been acquainted. It is quite distinct from *T. endlicherianum* in aspect, due to the more widely divergent segments, which make the frond wider and more open; and this openness is accentuated, producing an

appearance unique in the section, by the extreme narrowness of the segments. The tube of the involucre is drawn down gradually to a point, and the dilation of the mouth is gradual, but very great. The long receptacles are wanting on the cotype in the University of California Herbarium. Microscopic examination shows scattered minute hairs on the axis, even on the middle line of the involucre.

The species has been known only from the type collection, but I find it present in *Schlechter 17304*, from the upper Djamu river, altitude 700 meters.

34. TRICHOMANES VIEILLARDII van den Bosch. Plate 17.

Trichomanes Vieillardii VAN DEN BOSCH, Ann. Sci. Nat. IV 15 (1861) 90.

T. jungermannioides FOURNIER, Ann. Sci. Nat. V 18 (1873) 258.

Fronde oblonga vel lineari-oblonga pinnatifida, laciniis superioribus erectiusculis approximatis, inferioribus patulis remotis sublinearibus, margine in lobos dentiformes breves obtusos patulos simplices dichotomosve abeunte, cellulis teneris inaequalibus (parvis usque magnis) flavo-aureis, marginalibus seriatis hyalinis lineari-oblongis valde elongatis, soris in laciniis axillaribus vel lateralibus late alatis cylindricis, limbo ampliato (tubo usque triplo latiore), stipite vix ultra 5 mill. longo anguste alato. Rhizoma horizontale filare intricatum atro-fusco-tomentosum; frons 4 centim. circiter longa, vix ultra 10 millim. lata gracilis tenera ex olivaceo fuscescens.

Hab. Ad caudices filicum arborescentium, Balade [New Caledonia], VIEILLARD, herb. n. 1661.—Van den Bosch, loc. cit.

I have not seen original specimens of either *T. Vieillardii* or *T. jungermannioides*, but do have very ample material, of Franc's collections, from the Bonati herbarium and from Doctor Rosenstock, which blankets the two descriptions, and might provide types for an indefinite number of other species if the numerous forms were found in separate and uniform collections. In form of frond, it is the most unstable species in the group. The appearance of the most bizarre forms is a phenomenon analogous to the proliferation of *Gonocormus*, wherein occasional pinnæ assume the stature and form of small fronds. The fronds resulting from such behavior are too diverse for definition of form.

The great majority of fronds are characterized by the presence of short, more or less triangular segments or teeth, connected by broad laminar wings. Small and sterile fronds may have a single zigzag axis, a simple vein salient at each angle entering a tooth. Fronds of normal size, 3 or 4 cm long, may be composed entirely of primary segments (or pinnæ) like the simple fronds just described. But it is also common for some

of the primary segments to elongate without producing lateral teeth, or to produce lateral segments which are also elongate; and some fronds are destitute throughout of the toothlike segments.

Except as it is widened by the laminar connection of the teeth, the wing of the axes is usually narrow. Thus it may be almost wanting on the involucre (not shown in my figures); and on the lower part of the main axis it is sometimes (rarely) obsolete, the frond thus becoming really pinnate. The marginal cells are usually very long, and their cross walls very oblique. The outer wall is exceedingly thick, either throughout, as figured by Mettenius, Hymenophyllaceae pl. 1, fig. 31, or chiefly near the ends of the cells. The inner wall is hardly thicker than that of the ordinary laminar cells. The latter are less uniform than in some species, but less various than might be expected from van den Bosch's description.

The sori of the more symmetrical fronds are placed as in *T. humile*, but usually less exactly parallel to the axis. On fronds of irregular form, they lose their regularity of position, a primary segment rarely bearing more than one sorus, or a sorus not rarely occupying an entire primary segment. The mouth is very much dilated, usually more abruptly than my figures happen to show; it is usually considerably wider than the tube with its wings.

Known from New Caledonia only; and apparently growing only on tree-fern trunks. In Franc's collections (the numbers of which are not dependable), it is represented with us by *132, 708, 830* (received as *T. Milnei*), and *2005* (as *T. jungermannioides*); also, distributed by Rosenstock, by his *41* and *135* (as *T. subhumile* n. sp., an unpublished name).

CREPIDIA DUBIA

TRICHOMANES PERPUSILLUM v. A. van Rosenburgh, Bull. Jard. Bot. Buit. II 16 (1914) 37.

Eutrichomanes, Ptilophyllum.—Planta minima, caespitosa. Stipites sparsi, usque ad ½ cm longi. Frondes oblongae, tenues, glabrae, usque ad 1 cm. longae, profunde pinnatifidae, basi cuneatae vel decurrentes. Segmenta linearia, infra segmentum terminale ca 1–4 utrinque, lateralia erecto-patentia, usque ad 5 mm longa, ca ⅔ mm lata, sat abrupte acuta, stria (venula spuria) specie marginali, pallida, continua, ornata, venis centralibus pallidis, in segmentis solitariis. Sori pauci, in segmentis superioribus terminales; indusium infundibuliforme, alatum, basi acutum, apice patente dilatatum; receptaculum exsertum.

T. Nymani *Christ* differs from this by its subtufted fronds provided with black veins and bordered by a black spurious vein.

New Guinea (*Ramu, Schlechter 14157*).—V. A. van Rosenburgh, loc. cit.

I have not seen this. It may be a distinct species, or it may be a tiny form of some better known species. Except that it is somewhat smaller still, there is little in the description to distinguish it from a juvenile *T. humile*, from *T. concinnum*, for example, which is quite certainly a small *T. humile*. It may not be a *Crepidium* at all; *T. Nymani*, with which it is compared, is a depauperate *Taschneria*.

TRICHOMANES APICILARE Fournier, Ann. Sci. Nat. V 18 (1873) 257.

Fronde ambitu lineari-ovali, pusilla, vix 2″ longa, e rhizomate repente gracili enata, pinnata, pinnis linearibus simplicibus v. rarissime bifidis 2–3-jugis, venula spuria marginali instructis, in rhachidem alatam et in stipitem brevem marginatum decrescentibus, soris lacinias terminantibus, columella breviter exserta, ore integro.

Secus ripas cataractorum pr. *Wagap* [New Caledonia] (*Vieill. 2165* part.).—Fournier, loc. cit.

TRICHOMANES ASSIMILE Mettenius, Linnaea 35 (1868) 386.

Rhizoma tenerum; folia membranacea, flavo-viridia in costis nervisque pilis minutissimis obsita tripinnatipartita, hinc inde e medio petiolo s. e rhachi prolifera; petiolus ad 1½″ longus superne compresso marginatus pilis paleaceis setosus, rhachis alata; lamina 2½″ longa, 1″ lata oblongo-lanceolata; laciniae primariae patentes ovatae, infimae deltoideo-ovatae; secundariae late obovatae, ultimae lineari-oblongae, emarginatae, inferiores bifidae; nervi Caenopteridis; cellulae parenchymatis polyedricae, parietibus lateralibus plicatim incrassatae; sori axillares, immersi; indusium late alatum s. cylindricum ore ampliatum.

Novae Hebrides. Aneitium. (Herres n. 53.)

Praecedenti speciei [T. concinnum] proximum, sed foliis tripinnatipartitis, laciniis primariis sessilibus ovatis diversum. Affine etiam *Tr. prolifero* Bl. en. 224, a quo differt rhachi tereti s. compressa, laciniis primariis confluentibus. (K.)—Mettenius, loc. cit.

Referred to *Crepidium* because said to be near to *T. concinnum*.

TRICHOMANES PANICULATUM v. A. van Rosenburgh, Bull. Jard. Bot. Buit. II 16 (1914) 38.

Eutrichomanes Trichomanopsis? Tr. humile Forst. subsimile sed: Frondes majores, usque ad 7½ cm longae et 4 cm latae, 3-pinnatifidae vel sub-4-pinnatifidae, rachide primaria exalata, marginibus leviter sed distincte crispato-undulata; sori in planta adulta copiosi, in pinnis et pinnulis superioribus terminales, in pinnulis inferioribus axillares, in parte superiore frondis paniculati.

Plants with the lower pinnae resembling small specimens of T. humile *Forst.*, especially by the intramarginal spurious vein and sparingly glan-

duloso-fibrillose ribs but distinguished by the paniculate higher sori, and more or less crisped laciniae.

Java (*Klappa Noenggal*, C. A. Backer No. 5837).—V. A. van Rosenburgh, loc. cit.

Without seeing an authentic specimen, I cannot decide whether this is a form or relative of *T. humile*, or of *T. bilabiatum*.

7. TASCHNERIA; THE GROUP OF TRICHOMANES BIPUNCTATUM

Small ferns, usually epiphytic, with filiform, hairy rhizomes; fronds pinnate in plan, or in a few species becoming digitate by reduction, all or all but the strongest axes winged; false veins (*striae*, of Prantl) always present; involucre tubular or funnel-shaped, the mouth usually bilabiate, sometimes radially expanded, rarely truncate. The Old World Tropics, to Japan and New Zealand.

Presumably derived from the group of *T. pyxidiferum*, from which this group is distinguished by the presence of the false veins; with exceptions, *Taschneria* is distinguished further by the strongly bilabiate involucre. The striate species with simple or merely lobed fronds, *Didymoglossum*, are probably derived from *Taschneria* by reduction.

The false veins are critically important in the recognition of the group, and in minor degree in the discrimination of the species. This distinction of the species is difficult, first because they are much alike and variable, second because the false veins have been ignored in describing a number of them, and third because undue importance can be and has been attached to them. Hooker and Baker solved the difficulty by making *T. bipunctatum* (as *T. Filicula*) include all *Trichomanes* of the same general aspect with bilabiate involucre, including some species not even in this group. Van den Bosch used the other easy method, setting up many species, each known by one plant. Neither method has any merit except ease.

I have come positively to the conclusion that the evolution of a large part of the supposed species has been local. To illustrate: The Javan forms and the Philippine forms are distinct phyletic entities, and neither of these phyla is represented in India or in Polynesia or in Japan. In Java, van den Bosch distinguished three species, and his successors have added to the number. Likewise in the Philippines, several species have been described. A species must be a phyletic unit, whether this be large or small, uniform or varied. A species cannot comprise

phyletically distinct plants, however similar they may be, even to the point of apparent identity, unless it be so broadly conceived as to include the phyla they represent, back to the point of common ancestry. Purging it of such elements as *T. draytonianum,* which is not a *Taschneria, T. bipunctatum* might be a species including the whole group—but to-day's botanists do not tolerate such a species as it would then be.

To keep the number of species within bounds, and the species themselves in some measure describably distinct, but insistently restricting a specific name to a phyletic unit, I recognize one common species in Java and one common species in the Philippines. With as ample material, I suspect that the same course would seem proper in India. I am not at all satisfied as to what is in the Peninsula, and remain baffled rather than enlightened by the wealth of material in the Singapore Herbarium.

Unlike *Trichomanes* as a whole, *Taschneria* impresses me as a group in active evolution; and it is not in the nature of the case that the species of such a group should be clearly and uniformly distinct.

Besides *Didymoglossum anomalum,* which my more complete acquaintance with the Philippine ferns has enabled me to recognize as a dwarf of *T. brevipes,* there are a number of other species based on minute specimens. In spite of the evident fact that *Hemiphlebium* and *Microtrichomanes* have found a place in nature, I believe, analogous to the inability of dwarf races of men to hold their own in competition with races of the normal human size, that the chances are very strongly against the local evolution of any established dwarf race of *Taschneria* from the already small species of the common range in size. I believe rather that these minute supposed species represent either individuals fertile before they achieve the strength to produce the fronds of the same species in its fuller development—as happens well throughout the genus; or plants stunted by the environment, acting on the individual plants—as I know that an unfavorable change can cause a rhizome which has been producing normal fronds to produce a crop of much reduced, but fertile fronds; or plants growing from spores which germinate where the conditions do not permit the normal development of the species. A dwarf species might become fixed, in adaptation to such conditions; *T. latemarginale* may be an example. But, as long as such "species" are known by very few individuals, it remains probable that they represent other species, more of the character typical of the group.

Species described as minute and relatively simple are *T. intramarginale, T. latemarginale, T. rupicolum, T. Nymani, T. acuto-obtusum, T. palmifolium, T. pervenulosum,* and *T. minimum,* the last reducible to *T. bilabiatum.*

Because of its geographic range, far wider than that of any other species; because it is constant in the manifestation of reasonably characteristic form, structure, and—as compared with other species—size; because most other species are easily regarded as variants from the basic structural plan of this one; and because occasional plants referable as individuals to this one are found in many places where some one of the species construed as derived from this is dominant (atavism, reasonably to be expected), I regard *T. bipunctatum* as the oldest species of the group, and all others as derivatives from it. In the degree of departure from type, the sequence is roughly the population of: 1, the Malay Peninsula; 2, Java; 3, the Philippines, and 3*a* Papua; 4, the Indo-Sino-Japanese region. This sequence is not a phyletic one; except possibly as to 3 and 3*a*, and as 3 may be derived through 1, the forms of each area are regarded as independent derivatives from the common parent.

Key to the species of Taschneria.

Fronds of normal size, 3 to 10 cm tall, at least bipinnatifid.
- Submarginal false veinlet continuous, other striæ few or none.
  - Marginal laminar cells in 2 regular rows..... 35. *T. bipunctatum.*
  - Marginal laminar cells in one row..... 44. *T. intramarginale.*
- Submarginal veinlet interrupted, other striæ present.
  - Mouth of involucre bilabiate.
    - Segments commonly 0.3 to 1.1 mm wide, lips not very fibrous; Dutch Indies.
      - Lips distinctly shorter than tube..... 36. *T. bilabiatum.*
      - Lips about as long as tube..... 37. *T. Rothertii.*
    - Segments narrower, much fiber in lips.
      - Lamina full of false veinlets; Papua.... 41. *T. venulosum.*
      - Accessory striæ comparatively few; Philippines. 39. *T. brevipes.*
  - Mouth widely dilated, not bilabiate..... 40. *T. Christii.*
- Submarginal veinlet mostly obsolete; India to Japan. 47. *D. latealatum,* etc.

Dwarf forms, mostly digitate or pinnatifid.
- Intramarginal false veinlet present.
  - Marginal laminar cells in one row.
    - Frond monopodial; Ceylon..... 44. *T. intramarginale.*
    - Frond pinnatifid; Papua..... 42. *T. Nymani.*
  - Marginal cells in two rows.
    - Segments narrowly oblong; Asia..... 45. *T. latemarginale.*
    - Segments broadly oblong; Java..... 38. *T. rupicolum.*

Intramarginal strand obsolete.
Mouth dilated, hardly bilabiate ..... 43. *T. pervenulosum.*
Mouth strongly bilabiate.
Tube short ..... 48. *T. Makinoi.*
Tube long ..... 46. *T. megistostomum.*

35. TRICHOMANES BIPUNCTATUM Poiret. Plate 18, figs. 1 to 4.

T. bipunctatum POIRET, in Lamarck, Enc. 8 (1808) 69.
Hymenophyllum alatum SCHKUHR, Krypt. Gewächse (1809) 133, pl. 135b. non Swartz.
H. Filicula BORY, in Willd., Sp. Plant. 5 (1810) 528.
Trichomanes Filicula BORY, Dup. Voyage 1 (1849) 258.
Taschneria Filicula PRESL, Epim. (1849) 258.
Trichomanes punctatum CHRIST, non Poiret, Bot. Jahrb. 23 (1896) 336.

Trichomanes frondibus subtripinnatis, membranaceis pellucidis; foliolis subdecurrentibus; pinnulis pinnatifidis; laciniis linearibus, obtusis; fructificatione primò bipunctatâ dein subinfundibuliformi; columellâ exsertâ.

C'est une plante basse, haute de deux à trois pouces.

. . . Madagascar, par M. Aubert du Petit-Thouars.—Poiret, loc. cit.

Stipes 2 to 3 cm long, terete, hairy and dark at the base, winged in the upper part, rachis winged throughout, narrowly in the lower part; frond 5 to 8 cm long, lanceolate or ovate, tripinnatifid, segments 0.5 to 0.8 mm wide where bearing a single vein, up to 1 mm wide above the forking of the vein and up to the forking of the frond, clear or deep green, obtuse; false vein almost continuous, separated from the margin by two rows of laminar cells, other striæ absent or rare; sori occupying the lowest acroscopic pinnules or segments, involucre 2 mm long, tubular, slender, winged, conspicuously bilabiate, the lips commonly as long as wide, triangular, acute or somewhat obtuse, erect to flatly expanded; involucre expanded.

(Madagascar). Comores, *Hillebrandt.* Bourbon. Mauritius, *U. S. Nat. Herb. 593149 Mrs. N. Pike.* Common in Polynesia: Tahiti, *Vesco, Brackenridge, Setchell and Parks, MacDaniels, Grant.* Tahaa, Huahine and Moorea, *Grant.* Rarotonga, *Parks.* Samoa, *Brackenridge, Reinecke, Whitmee.* Fiji, *Brackenridge, Prince, Parks, Horne.* Admiralty Islands, *Moseley* (mixed with *T. humile*). Vanicolla. New Zealand. New Caledonia, *Balansa 2697, le Rat 2890, Franc 428;* but *Balansa 69* in the Bureau of Science herbarium is intermediate between this and *T. venulosum.* Reported from Queensland, whence my only specimen so named, *Simmonds,* is distinct.

From New Guinea, I have no specimen referable to this species in any strict sense. *Trichomanes bipunctatum* var. *nana sub-*

flabellata Christ, *Lauterbach 914*, is a sterile dwarf, which might represent any species in the group. *Trichomanes bipunctatum* var. *venulosum* Rosenstock is better treated as a distinct species, to which I refer other collections. Neither do I find *T. bipunctatum* in India, China (except Hainan), or the Philippines, from all of which many specimens have been given this name (or *T. Filicula*).

The condition in the Peninsula is peculiar. Very many specimens are *T. bipunctatum*, very nearly, differing only in being smaller, commonly 2.5 to 4 cm tall exclusive of stipe, and in being likely to have a very few striæ besides the intramarginal false vein, or to have the latter more broken than is typical. The distinctions are not such as to make specific recognition practical, and I have therefore decided to regard *T. bipunctatum* as the dominant representative of the group here, as *T. bilabiatum* is in Java and *T. brevipes* in the Philippines. This form ranges north to Hainan: *Eryl Smith 1400*.

In Sumatra and Borneo, under these conditions, a mixture is to be expected, and is found. Of Borneo specimens, *Clemens 9955* and *Topping 1806* from Kinabalu, and *Brooks 170* (October 1, 1909) from Sarawak, are passable *T. bipunctatum*. *Brooks 23* (September, 1908) is a specimen which, like the fish in the Arabian Nights, combines the fine features of all its relatives; it has the stature of a large *T. bilabiatum*—12 by 6.5 cm—the aspect (broad, compact frond with narrow segments) of *T. Christii*, and the lips and venulation of *T. bipunctatum*. *Topping 1600* has rounded lips. *Hose 729* has almost linear lips like a Mindanao relative of *T. brevipes*.

Of Sumatra specimens, *Burchard 129*, *Winkler 175*, *Bartlett 7745*, *7746*, *7676*, *6405*, *6725*, and *7048*, and *Mousset 2206* are referable to *T. bipunctatum*. As to Java, van den Bosch's plate 26, *Didymoglossum Filicula*, represents this species more perfectly than any specimen I have seen except one from Kota Batoe by *Raciborski*, but *Bakh. v. d. Brink 557*, *5923*, and *6270* can bear this name. They are all from comparatively low country, at most 550 m altitude, while *T. bilabiatum* is a plant of the high mountains. The specimens cited by van den Bosch, however, are montane. I do not know whether any Java specimens are really *T. bipunctatum*, or whether those which might be are aberrant *T. bilabiatum*.

With the exception of the Peninsula, where I am afraid that I have left this a "collective species," the only place from which

I have been able to study enough material to show its variability is Tahiti. The ample collections of Setchell and Parks and Grant show that it produces fertile dwarfs, not open to reasonable construction as specifically distinct, such as are responsible for the improper description of species throughout the genus. *Setchell and Parks 290* contains fertile fronds only 12 mm long.

Among the Peninsula collections, in *Henderson 10700*, no individual frond of which is more than 2 cm long, I find a fertile frond 10 mm long by 7 mm wide.

36. TRICHOMANES BILABIATUM Nees and Blume. Plate 18, figs. 4 and 5.

T. bilabiatum NEES and BLUME, Nova Acta 11 (1823) 123, pl. 13, fig. 2; BLUME, Enum. 226.

Didymoglossum Filicula VAN DEN BOSCH, Hymen. Javan. 35, pl. 26?

D. laxum VAN DEN BOSCH, Hymen. Javan. 37, pl. 27.

T. capillatum TASCHNER, Diss. (1843) 34, pl. 1, figs. 2, 4, 6.

Didymoglossum capillatum VAN DEN BOSCH, Hymen. Javan. 38, pl. 28.

T. bilobatum V. A. VAN ROSENBURGH, Bull. Jard. Bot. Buit. II 20 (1915) 24.

T. minimum V. A. VAN ROSENBURGH, Bull. Jard. Bot. Buit. III 2 (1920) 175.

Tr. frondibus pinnatis, pinnis ovatis bipinnatifidis decurrentibus, laciniis linearibus bifidis obtusis integerrimis, soris supraaxillaribus ore bilabiato, rachi stipiteque alatis.

* * * * * * *

Descr. Caudex crassitie fili lintei fortioris, repens, ramosus, setulisque densis patentibus fuscis hispidus. Stipes octo lineas longus, compressus, ala membranacea tenui ad basin decrescente cinctus. Frons pollicem unum ad duos longa, cordato-ovata, tenuis, lutescens, pinnata. Pinnae in alam racheos angustam confluentes, 6–8 lin. longae, patentes, alternae, ovatae, acutae, pinnatifidae, planae. Laciniae cuneiformes, inferiores pleraeque iterum pinnatifidae, superiores pinnarumque maxime fertilium plurimae tri- vel bifidae. Lacinulae lineares, bifidae integraeve, omnes integerrimae, nervo medio saturate viridi lineaque haud procul ab utroque margine decurrente notatae, laxe reticulatae. Sorus pinnularum laciniae inferiori et superiori immersus, hinc subaxillaris, et Indusio, (quod appellamus,) cuneiformi, compresso alaque membranacea cincto sessili apice bivalvi totus reconditus. Valvulae, ex indusii margine ortae, dehiscentes, ovatae, obtusae, indusio plus duplo breviores. . . .—Nees and Blume, loc. cit.

Distinguishable from *T. bipunctatum* by less regularity of the spurious venation, the submarginal venule being interrupted and irregular, and other, shorter, commonly oblique and irregular striæ being present. Also, the lips of the involucre are usually obtuse or rounded, and the segments of the frond are commonly broader, 0.8 to 1.1 mm in width. The involucre of robust fronds is likely to be 3 mm long, tubular, and broadly winged.

Exceedingly variable, whence the number of names, all applied to Javan types. I have not seen the type collections of *T. bilobatum* and *T. minimum*, but there is nothing in the description of either which is not to be found in the collections in hand. *Trichomanes bilobatum* should be without the submarginal false vein; I find this true of a part of the fronds of *Palmer and Bryant 726* and *Yates 2997*. *Trichomanes minimum* is a small form, without accessory striæ. By definition, it would be *Didymoglossum anomalum*, the corresponding dwarf of *T. brevipes;* but it is certainly more reasonable to refer it to the normally larger Javan species.

Beyond Java, I refer to this species an unnumbered *Burchard* plant and *Bartlett 6538*, from Sumatra. A number of specimens from the Peninsula are like *T. bilabiatum*, but I can draw no definite line there between these and those referable rather to *T. bipunctatum*. It is a curious fact that still farther north specimens recur which are like *T. bilabiatum* in all respects except narrower segments—*Eberhardt*, from Hanoi, and *Pételot 4074, 4075* from Chapa, all from Tonkin.

Werner 18 and *Schlechter 17304*, from Papua, distributed as *T. bilabiatum* might be this species if from Java, although there is more sclerenchyma in the lips; but they are small plants, and I believe that this is the reason there is less sclerenchyma in the lamina than in the larger plants from the same collectors, *Werner 60* and *Schlechter 16370*, which are referred to *T. venulosum*.

37. TRICHOMANES ROTHERTII v. A. van Rosenburgh.

Trichomanes Rothertii v. A. VAN ROSENBURGH, Bull. Jard. Bot. Buit. II 1 (1911) 13.

Eutrichomanes, Ptilophyllum.—T. humili affine sed venulis spuriis marginalibus carentibus, et venulis spuriis accessoriis inter marginem et costulas copiosis, erecto-patentibus, irregulariter sparsis praesentibus.

Differs from T. humile by the absence of the marginal spurious vein and the presence of numerous erecto-patent, irregularly scattered spurious veinlets between the margin and central veins. Fronds ovate in general outline, up to 5 cm. long, to 2 cm. broad; veins 1 in each ultimate segment, not reaching the apex of the segment, naked or provided with minute, distant, fibril-like scales. Sori solitary on the upper side of the primary segments at the base, or on both sides of them; tube with the mouth hardly dilated, conspicuously 2-lipped, the lips triangular, erect or somewhat spreading.

Java (*Preanger Regencies*, Dr. W. Rothert.).—V. A. van Rosenburgh, loc. cit.

The foregoing diagnosis is obviously in error, because no fern with nonmarginate fronds, and with many oblique false

veinlets, can be located by affinity to *T. humile*. I have not seen an original specimen, but find in the herbarium of the Singapore Botanical Garden a specimen, *Holttum 15479*, collected at Brastagi, Sumatra, identified as this species, and conforming to what there is of a description. It is an immediate relative of *T. bilabiatum*, distinguished by smaller size and large, narrow, divergent lips. The lips are about as long and wide as the tube. Plants with similar sori in Mindanao and New Caledonia are derivatives, respectively, of *T. brevipes* and *T. bipunctatum*.

38. TRICHOMANES RUPICOLUM Raciborski. Plate 19, fig. 2.

Trichomanes rupicolum RACIBORSKI, Pterid. Buitenzorg (1898) 24.

Rhizom kriechend, sehr dicht abstehend behaart, mit der Behaarung 0.5–1 m.m. dick. Blattstiele fadendünn, 1–3 m.m. lang, mit wenigen Haaren bedeckt, fast nackt. Lamina bis 1 c.m. breit und lang, im Umriss gewöhnlich verkehrt dreieckig, gegen die Basis verschmälert oder etwas abgerundet, an der Spitze im sehr wenige (3–5, gewöhnlich 3) kurze oder längere, 2 m.m. breite, bis 1 c. m. lange, ganzrandige durchsichtige, lebhaft grüne an der Spitze flach abgerundete Lacinien fingerförmig getheilt. Nerven mit kurzen, spitzen Schuppen zerstreut besetzt. Neben dem Blattrande, in unterbrochenen Zügen verlauft ein Randnerv. Sori gewöhnlich einzeln auf einem Blatt, conisch, von der Blattlamina umsäumt, an der Mündung sehr stark erweitert, und mit tellerförmigen Lippenrand über den Laminarand hervorragend, bis 1.2 m.m. breit (an der erweiterten Mündung), bis 2 m.m. lang.

Von anderen javanischen kleinen Trichomanes-Arten durch äusserst kurze Stiele und Vorhandensein der Randnerven verschieden. An den beschatteten vulkanischen Felsen am G. Pantjar, in der unteren Waldzone.—Raciborski, loc. cit.

Of this species, the Bureau of Science herbarium at Manila contains ample material of Raciborski's, presumably the type collection. It is what should be expected from the extreme reduction of *T. bilabiatum*, with one notable feature that the involucre is obconic, with immersed tube, rather than elongate with winged tube, being more like that of *Microtrichomanes* than of *Taschneria*. As the same modifications have been undergone in the reduction to *T. latemarginale*, they may be regarded as mechanical incidents to extreme shortening of the frond.

A part of the fronds, and these the largest and most likely to be fertile, are pinnate in architecture; others are apparently digitate. The false veinlet is irregular, much or little interrupted; separated from the margin by two rows of laminar cells, or less often approaching the margin, the same veinlet wandering to and from the margin; accessory striæ can be detected in a few fronds; traces of the false veinlet are present in some, but not in all, lips of the involucre. The involucre is

not really bilabiate, but the mouth is more expanded at a right angle to the plane of the frond than in that plane.

Apparently, known only by the type collection.

Trichomanes Aswijkii Raciborski, which I have not seen, must be very like *T. rupicolum* in gross aspect, but the brownish color of dry specimens and the absence of false veinlets establish its affinity to *T. nitidulum*, a *Microtrichomanes*.

39. TRICHOMANES BREVIPES Baker. Plate 20.

T. brevipes BAKER, Syn. Fil. (1867) 84.

Didymoglossum brevipes PRESL, Hymen. (1843) 139; VAN DEN BOSCH, Hymen. Javan. 38.

D. undulatum PRESL, Hymen. (1843) 140.

Trichomanes bilingue HOOKER ex J. Smith in Hooker's Journ. Bot. 3 (1841) 417, nomen.

T. melanorhizon HOOKER, Sp. Fil. 1 (1844) 140; Ic. Pl. pl. 705.

Crepidomanes intramarginale PRESL, Epim. (1849) 258, as to the Luzon plant only.

Didymoglossum anomalum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1863) 140.

D. fronde breviter stipitata oblongo-lanceolata acuta pinnata, pinnis subsessilibus oblongis obtusis profunde bipinnatifidis glaberrimis, infimis horizontalibus, laciniis oblongo-lanceolatis obtusis, secundariis (lacinulis) linearibus obtusis integerrimis, soris exsertis sessilibus, indusio infundibuliformi alato-marginato, limbi laciniis subrotundis, rachi superne alata, inferne stipiteque subnuda pubescente.

Habitat in insulis Philippinis, verosimiliter in insula Luzon, unde retulit clar. Cuming et aliis plantis immixtum sine numero communicavit.

Rhizoma longe repens, teres radicibusque ramosis paleis piliformibus densissimis nigricantibus tomentellum. Stipes duas-tres lineas longus, pilis brevibus horizontalibus pubescens, in fronde fertili teres nudus, in fronde sterili duplo minori basi teres apice alatus. Frons fertilis semiquartum, sterilis vix duos pollices longa, utraque ex ovata basi oblongo-lanceolata acuta pinnata excepta racheos basi glaberrima. Pinnae quinque-septem-lineales, subsessiles, profunde bipinnatifidae, obtusae, in fronde sterili oblongo-lanceolatae, in fertili oblongo-ovatae, infimae horizontaliter patentes, omnes approximatae. Laciniae primariae oblongo-lanceolatae obtusae, secundariae anguste lineares obtusae integerrimae. Rachis frondis fertilis inferne teres pubescens, superne alata, frondis sterilis undique alata basi pubescens. Costa tenuissima, flexuosa. Venae pinnatim exorientes, pinnatim ramosae, venula in qualibet lacinia secundaria (lacinula) unica apice libera. Parenchyma e cellulis rotundato-hexagonoideis minutis constructum. Sori in suprema parte frondis obvenientes, exserti, sessiles, pauci. Indusium lineam longum, infundibuliforme, angustissime alato-marginatum, limbo bipartito, laciniis subrotundis conniventibus integerrimis. Receptaculum setaceum, indusio longius, integrum non visum, basi capsuliferum.

Valde affine D. Filicula, differt brevitate stipitis, figura pinnarum magis approximatarum et directione inferiorum, brevitate indusii evidentius pe-

dicellati et latius alati, laciniis secundariis angustioribus integerrimis.—Presl, loc. cit. (1843).

This is followed immediately by the publication of *Didymoglossum undulatum* Presl, Hymen. (1843) 140, represented as without false veins, and with broad undulate wings on rachis and stipe, and narrower fronds. Since Presl had denied the reality of the false veins, in a supplementary comment on *D. brevipes*, mistaking them for folds or wrinkles, he consistently maintained his error in dealing with the second species. In Christensen's Index, *D. brevipes* is reduced to *T. bilabiatum* and *D. undulatum* to *T. bipunctatum*. Only an examination of the Presl types can settle their identity beyond question, but I have practically no doubt that they are one species. They are cited alike as based on a mixed collection, without number, by Cuming. Fronds fitting both descriptions, with allowance for Presl's error as to the false veins, are included in *Cuming 2*, from Luzon. As was recognized by Smith, *Cuming 2* and *316*, the latter from Leyte, are one species. *Cuming 316* is the type collection of *T. melanorhizon* Hooker.

As noted by van den Bosch, Hymen. Javan. 38, it is near *T. bilabiatum*, but distinguishable by being more lax, with narrower segments, commonly 0.5 mm or less in width; it is usually smaller, and with fewer false veins. Presl, though denying their reality, characterized these very well, as most irregular in their occurrence. A single submarginal one, as described by van den Bosch, is rarely if ever present. While not abundant in the lamina, their development in the lips of the involucre is conspicuous. Here they may form solid plates, or may be largely in strands separated by ordinary cells; but in most cases they make up a considerable part of the tissue of the lips.

The genus *Crepidomanes* was based on Hooker and Greville, Ic. Fil. pl. 211, which supplied the specific name; on *Cuming 150;* and a larger Javan specimen not further identified. The last should be the plant recently renamed *T. minutum* (see *T. bilabiatum*).

The real *T. intramarginale* is a Ceylon dwarf, with very different sorus. *Cuming 150* was not named by Smith, who had an imperfect specimen. The specimen in the Gray Herbarium is presumably better, and permits recognition as a dwarf identical with *Cuming 2*. My guess is that both were collected in Laguna Province, as was also the Brackenridge plant recognized by the collector as *T. melanorhizon*, but later described

as *D. anomalum;* the last and *Cuming 150* are identical in detail. *Crepidomanes* as a genus has priority of position on the page over *Taschneria.* Also, it is characterized, while *Taschneria,* merely named with a species, is doubtfully published. If the group be raised to generic rank, distinct from *Trichomanes* and *Didymoglossum,* its name is therefore *Crepidomanes;* but for it as a group or section, without formal status, *Taschneria* is preferable, typifying it by a normally developed plant instead of a dwarf, and by the first-named and most typical species.

Didymoglossum anomalum is the named dwarf form of this species, *Cuming 150* having escaped by misidentification. These dwarfs occur throughout the Archipelago, and must not be construed as varieties. The most extreme case is *Elmer 9625,* from Negros, which has no frond more than 5 mm long, but several of them fertile. It is absolutely identical in structure with *Ridley 15700,* from Kedah, which I call *T. latemarginale* (= *T. nanum* van den Bosch, = *T. Kurzii* Beddome); but I entertain no doubt that it is a local derivative of *T. brevipes,* nor that the similar continental plants are local derivatives of their normally larger neighbors.

Trichomanes brevipes is very common throughout the Philippines and represented in herbaria by at least fifty collections. As these are mostly distributed as *T. bipunctatum,* which I do not recognize in the Philippines, it is unnecessary to enumerate them. Like its relatives, it is exceedingly variable. There are also recognizable local forms, but these are not distinct enough to merit specific recognition. *Cuming 316,* the type of *T. melanorhizon,* from Leyte, represents one of these, most similar in aspect to *T. Christii.* The most distinct such form occurs, along with more typical plants, in Mindanao, and has narrow lips of the involucre about twice as long as wide. I do not name and describe it, because I know just such forms derived from *T. bipunctatum* and *T. bilabiatum,* and prefer not to be responsible for a series of "species" exceedingly similar but distinct in phylogeny.

Beyond the Philippines, I construe two specimens from Guam as this species. *Topping 1813,* from Mount Kinabalu, is this, rather than *T. bipunctatum.* As it is the species most nearly like *T. venulosum,* of Papua, it is reasonable to expect it to be found in Papua. Also, as it is found in the Batanes, I think it probable that the plant reported in Formosa as *T. bipunctatum,* which I would not expect to find there, is really *T. brevipes.*

40. TRICHOMANES CHRISTII Copeland. Plate 21.

T. Christii COPELAND, Philip. Journ. Sci. 1 (1906, Sept.) Suppl. 251, non CHRIST, Bull. Herb. Boiss. II 6 (1906, Nov.) 988, nec ROSENST., Bull. Jard. Bot., Buit. II 2 (1911) 27.

T. recedens ROSENST., Meded. Rijks. Herb. Leiden 11 (1912) 2.

T. microlirion COPEL., Philip. Journ. Sci. 10 (1915) Bot. 146.

T. brevipes C. CHR., Gard. Bull. Straits Settlements 4 (1929) 377, non Baker.

Rhizomate late repente, 1 mm. crasso; stipitibus tenuibus, ca. 1 cm. altis, pilis brevissimis paucis pubescentibus; fronde 5–8 cm. altis, 25–35 mm. latis, acutis, tripinnatifidis; rhachi sursum anguste alata; pinnis oblongis, obtusis, infimis diminutis; segmentis integris, linearibus; urceolis infundibuliformi-campanulatis, anguste alatis alis saepius sub limbo evanescentibus, limbo leviter elato, subbilabiato, receptaculo incluso.

[Philippines:] MINDORO, prope fluminem Baco. *Merrill 1819.*

Near *Trichomanes pyxidiferum* and *T. bipunctatum*, easily recognized by the comparatively large frond and short stipe, and included receptaculum.—Copeland, loc. cit.

Christ two months later published a diagnosis independently, basing it on a specimen collected in Rizal by Loher. Details of difference are: "Rhizoma tenue;" "stipite 4 cm. longo;" "rachi omnino exalata;" "fronde 10 cm. alta;" "urceolis 1 mm. longis campanulatis bilabiatis, labiis dilatatis, receptaculo subexserto." If correct, Christ's description applies to a specimen of *T. brevipes*.

A species exceptionally distinct in this group of ill-defined species, recognizable by the broadly expanded but not bilabiate lip of the involucre. It is an epiphyte, commonly long-creeping on slender branches of shrubs and trees, with black-hairy rhizomes, fronds usually remote, short-stiped, broad, ample but compact, with many slender segments, commonly 4 to 6 cm long and 2.5 to 4 cm broad, the lowest pinnæ reduced or not so; false veinlets not strikingly developed, commonly with a much-interrupted and irregular submarginal strand, like that of *T. bipunctatum* in position, and with or without a few minor striæ; sori restricted to the apical part of the frond, sometimes so strictly as to produce a paniclelike or racemelike inflorescence in which no sterile segments occur.

In aspect of frond, this is somewhat similar to the form of *T. bilabiatum*, pictured as *Didymoglossum laxum* by van den Bosch, Hymen. Javan. pl. 27. The affinity, however, is rather to *T. brevipes*, and to the form of that species which is *T. melanorhizon* Hooker, from which it is distinguished by the form of the involucre and the weak development of fiber cells in the

mouth. I suspect that they are near enough together to hybridize in Leyte.

The range is from the central Philippines south to Mindanao, west across Borneo to Sumatra, north along the Peninsula, to Siam. As the species is not well known and has been confused with *T. bilabiatum*, I cite the collections in hand.

MINDORO, the type. POLILLO, *Bur. Sci. 10290 McGregor.* NEGROS, *Copeland s. n.* SAMAR, *Bur. Sci. 24837 Edaño.* LEYTE, *Bur. Sci. 41743, 41750 Edaño, Wenzel 425.* MINDANAO, *Elmer 14020, Merrill 8009, Bur. Sci. 36844, 36967 Ramos and Edaño.* PALAWAN, *Merrill 7268.* BORNEO, *Brooks 172,* the type of *T. microlirion;* several unnumbered collections by Brooks, and Brooks and Hewitt; *Boden Kloss 18693.* SUMATRA, *Rahmat 318.* SINGAPORE, *Holttum; Ridley.* The Peninsula, *Holttum 9494, Ridley 8664, 12540, 13473, Goodenough 8960, Henderson 22546, Md. Nur 11929, Hullett, Dr. King's collector 4815.* Atypical in having a more slender and lax frond are *Ridley 14200* from Perak, and *Eryl Smith 1804,* from Siam. *King 340,* from Papua, looks like *T. Christii,* but is sterile.

The reduction of *T. recedens* is on the authority of Christensen, in Gardens Bulletin 4 (1929) 377, and in notes on my specimens; I do not doubt its correctness, but have not seen the type collection.

41. TRICHOMANES VENULOSUM (Rosenstock) Copeland comb. nov. Plate 22, figs. 1 and 2.

T. bipunctatum Poiret var. *venulosa* ROSENSTOCK, Hedwigia 56 (1915) 350.

Varietas venulis spuriis creberrimis, saepe reticulatim confluentibus, badiis, inde luce transmissa valde conspicuis a typo diversa.

Nova Guinea: in monte Sattleberg dicto. IV. 1914 leg. G. Bamler no. 117.—Rosenstock, loc. cit.

Distributed by Rosenstock as *Fil. novoguineenses 211.*

I have the same plant from the same mountain, collected by Zahn in 1905. Other specimens of the same form are *King 445,* from Ambasi, and *Werner 60,* from Damun. Before noticing its identity with Rosenstock's variety, I recognized *Schlechter 16370* as specifically distinct from *T. bipunctatum,* and had it illustrated. It is the same species, in a more amply developed form. *Schlechter 17304* is a dwarf form of this species, with fertile fronds 2 to 3 cm long; *Werner 18* is intermediate between this dwarf and the typical plant. *King 464,* from the Hydrographers' Range, is another small plant, the material inadequate for confident identification.

Stipes 2 to 3.5 cm long; well-developed fronds 6 cm long, 3.5 cm broad; segments about 0.6 mm wide; false veins notably abundant, irregular, not remarkable in color in most specimens; lips of the involucre triangular, acute.

Most nearly related to *T. brevipes*, from which it is distinguished by longer stipes and more copious false venulation. Judging by far less numerous specimens, it averages larger, and is less variable.

This seems to be the common representative of the group in New Guinea. From any other land, the only specimen in my hands suggesting it is *Balansa 69*, from New Caledonia, intermediate between it and *T. bipunctatum*.

42. TRICHOMANES NYMANI Christ. Plate 19, fig. 4.

Trichomanes Nymani CHRIST in Schumann and Lauterbach, Flora . . . Südsee Nachtr. (1905) 36.

In arborum cortice caespitosum.

Rhizomate ramuloso repente sublignoso fragili tenui nec filiformi parce brunneo-hirsuto, frondibus caespitoso-approximatis erectis 1 ad 1½ cm longis ½ cm latis ovatis basi subcuneatis simpliciter pinnatifidis subsessilibus, rachi anguste alata. Pinnis 3 aut 4 utroque racheos latere, linearibus 2 ad 3 mm longis ⅓ mm latis acutis fere mucronulatis, pinnis supremis abbreviatis rarius productis et subflabellatim dispositis. Margine pinnarum linea incrassata nigra cincto undulato hic illic denticulato. Pinnis uninerviatis. Colore dilute griseo-ochroleuco sive subvirente, textura diaphana, nervis rachique nigris.

Soris raris 1 aut 2 terminalibus in pinnarum supremarum apice, minutis ½ mm latis et longis exacte campanulatis id est orificio ampliato, usque ad os alatis, labiis non dilatatis, receptaculo brevi sed exserto.

Kaiser-Wilhelmsland; Sattelberg, an Baumstämmen auf dem Gipfel (Nyman n. 506, Jan. 1899).

Haec plantula sistit formam typi T. pyxidiferi quam maxime reductam, ob pinnas simplices et dimensiones pusillas. Pinnis acutis subdenticulatis inter gregem peculiare. . . .

T. Kurzii Bedd. . . . pinnis partitis gaudet. . . .; T. Lauterbachii. . . . magis dissectum; . . .—Christ, loc. cit.

Represented in the University of California herbarium by *Schlechter 16616*, received as *T. Nymani* from Prince Bonaparte, apparently correctly named; but I detect no sign of denticulation. The fronds are spaced about 5 mm apart on a rhizome slender enough to be filiform, but crooked. The larger fronds, about 16 mm long, have a narrowly winged rachis, the few primary segments simple or deeply cleft, rarely trifid, the ultimate segments about 0.6 mm wide, and I believe, obtuse when mature. The submarginal false vein is exactly as in *T. intramarginale;* that is, separated from the margin by at most the full width

of one row of marginal cells. The involucre is bilabiate, with short, subacute lips. There is no structural evidence by which to associate this with any particular larger plant.

Known from Papua only.

43. TRICHOMANES PERVENULOSUM v. A. van Rosenburgh. Plates 19 and 22, fig. 3.

Trichomanes pervenulosum V. A. VAN ROSENBURGH, Philip. Journ. Sci. 11 (1916) Bot. 103, pl. 5, fig. 2.

Gonocormus.—Rhizoma repens, filiforme, copiose ramosum, probabiliter caespitosum, ferrugineo-tomentosum, demum saepe glabrum. Stipites sparsi, filiformes, 0.5 ad 5 mm longi. Frondes tenuissimae, glabrae, simplices vel saepius 2-3-fidae, basi cuneatae ad anguste longe decurrentes, segmentis primariis erectis, erecto-patentibus vel patentibus, simplicibus vel furcatis vel raro irregulariter furcato-flabellatis; frondes simplices lineares, 5 ad 15 mm longae, 1.5 ad 2 mm latae, costatae, integerrimae, apice rotundatae et interdum emarginatae; frondes divisae 5 ad 20 mm longae, 3 ad 20 mm latae, segmentis ultimis brevissimis vel usque ad 15 mm longis, parte superiore frondium simplicium similibus; venae desunt; venulae spuriae adsunt, copiosae, breves, rectae vel leviter curvatae flexuosaeque, erecto-patentes vel costae marginive parallelae. Sori 1 vel plures, ad frondem simplicem vel ad segmenta frondium divisarum solitarii terminalesque; indusium infundibuliforme, immersum, limbo dilatato, patenti, vix 2-valvi; receptaculum non vel breviter exsertum.

AMBOINA, Hitoe lama, *Rel. Robins. 1947*, November 6, 1913, on limestone rocks, altitude about 100 meters.

This species resembles in aspect *Trichomanes Aswijkii* Rac., which, however, is larger and without spurious venules.—V. A. van Rosenburgh, loc. cit.

Known by the type collection only. Of all the dwarf species described in the group, this is the least susceptible of identification with any known larger species; the affinity is to *T. venulosum.*

THE SPECIES OF THE INDO-SINO-JAPANESE REGION

The word species is singular or plural. I am satisfied that the *Taschneria* population of this area is a phyletic entity, but am undecided as to whether it is best regarded as comprising one, or a few, or very many species. Even where I have indicated reduction, the action is consciously tentative. The first species described happened to be two dwarfs, *T. intramarginale* and *T. latemarginale.* Next in order are six species described as *Didymoglossum* by van den Bosch. As the status of all of these has been regarded as dubious, I will present in full the description of the second one only; it is recognized as a variety by Baker and by Beddome; and give abstracts of the others.

44. TRICHOMANES INTRAMARGINALE Hooker and Greville. Plate 23, figs. 1 to 3.

Trichomanes intramarginale HOOKER and GREVILLE, Ic. Fil. (1831) pl. 211; BEDDOME, Ferns of Southern India pl. 208.

Pumilum, frondibus erectis subbipinnatifidis, laciniis paucis lato-linearibus erecto-patentibus subundulatis opacis costatis nervo tenui paulo intra marginem sito apicibus retusis, involucris in apicibus laciniarum terminalium cylindraceo-campanulatis, ore patente brevissime bilabiato.

HAB. Insula Zeylonae. Communicavit *Prof. Lindley.*

* * * * * * *

Stipites perbrevibus, vix semiunciam longi, subtomentosi, superne alati. *Frons* unciam longa . . . ; laciniae paucae. . . .

Involucra . . . omnino immersa, ore paululum dilatato. . . .— Hooker and Greville, loc. cit.

I illustrate this species by a Gray Herbarium specimen, *Thwaites Ceylon Plants 3361.* Hardly identical, although in conformity with the description, is *Holttum 18312,* from Pulau Penang. Beddome cites two localities in peninsular India.

It is 2 to 4 cm tall, 10 to 15 mm wide, sparingly bipinnatifid in the lower part. It differs from *T. bipunctatum,* structurally, in that the false vein is closer to the margin, separated therefrom by at most one full row of marginal cells; and in the fructification, in that the involucre is so broadly winged as best to be described as sunk in the apex of the segment, quite to the point of separation of the lips or lobes, in a manner familiar in *Microtrichomanes* and *Hemiphlebium.* The tube is obconic, which is a characteristic of the group in India, and the lips are broadly rounded.

If any of the more amply developed supposed species be identified with this, the name will still be *T. intramarginale.* Judging by the descriptions, *Didymoglossum Griffithii* seems likely to be such a plant.

45. TRICHOMANES LATEMARGINALE Eaton. Plate 24.

T. latemarginale EATON, Proc. Am. Acad. 4 (1859) 111.

T. nanum VAN DEN BOSCH, Ned. Kruid. Arch. 5[3] (1863) 206, non Hooker.

T. Kurzii BEDDOME, Ferns Brit. India (1868) pl. 286.

T. viridans METTENIUS, Linnaea 35 (1868) 389.

T. formosanum YABE, Bot. Mag. Tokyo 19 (1905) 31, figs. 1–4.

T. palmifolium HAYATA, Ic. Formos. 4 (1914) 138, fig. 78.

Pusillum; caudice repente filiformi tomentoso; frondibus subsessilibus 3–6 lineis longis pellucidis glabris nunc palmato 3–6-partitis nunc pinnatifidis, laciniis lineari-oblongis integerrimis obtusis nervilla intra duplicem seriem cellularum marginalium cinctis; involucro omnino immerso infundibuliformi breviter bilabiato; receptaculo longe exserto; areolatione hexagonali conspicua fragmentis venularum conspersa.

Creeping on rocks in mountain ravines, near Hong Kong, China.—Eaton, loc. cit.

Collected by Charles Wright. The type collection, in the Gray Herbarium and United States National Herbarium, is composed in considerable part of digitate fronds, but the fertile fronds are pinnate in plan, even if with as few as four or five simple pinnæ; the largest are 16 mm long and 11 mm wide, with some of the primary segments subpinnatifid. I have three later collections, from the Hong Kong herbarium, all with subbipinnatifid fronds, about 2 cm long and 1 cm wide. Little as they are, they vary widely; and as I have already shown, unimportant meric variation in so small and simple a plant may involve a conspicuous modification in the terms which describe it. Besides varying from digitate to bipinnatifid, and from lanceolate to round, without any really important difference at all, they vary internally. The submarginal false vein may be little or much interrupted, and accessory striæ may be few or none, all on fronds of the same (type) collection. More remarkable, this submarginal false veinlet may, with or without interruptions, extend around the lip, or it may be entirely absent there—something I have seen in no other member of this group. The development of the mouth of the involucre is also variable. Most often, it has two broad lobes, rather than two lips, the distinction being that the mouth is dilated where they meet; these lobes may be prominent or inconspicuous.

I reduce *T. nanum* van den Bosch to this species on the evidence of *Ridley 15700*, from Kedah; it conforms exactly to van den Bosch's description, but could be duplicated by a selection of fronds from the type collection of *T. latemarginale;* and the geographic origin does not demand the assumption of distinct ancestry. *Trichomanes nanum* was described from Assam. *Trichomanes Kurzii*, described from the Andamans, is reduced on the strength of Beddome's own reduction, Ferns of British India correction sheet, of his species. It was originally described as having no lips, but in Ferns of British India and Ceylon, page 40, Beddome states that the mouth is dilated. *Trichomanes viridans*, described from Moulmein as 1 inch long, was distinguished from *T. nanum* by having the sori terminal on the fronds or the upper segments; but Beddome so depicted *T. Kurzii*, and it is the commonest position in *T. latemarginale*. Beddome's description and drawing, as *T. pusillum*, Ferns Brit. India pl. 302, would make me doubt the propriety of this reduction, showing numerous oblique striæ but no trace of a

submarginal vein; but Mettenius said *"nervi spurii striaeformes interrupti margini subparalleli."* I have likewise not seen authentic *T. formosanum,* but its description and figures might as well have been based on the type collection of *T. latemarginale.* By comparing it only with *T. vitiense,* in a different group, its author made it appear very distinct.

I suggest this identification of *T. palmifolium* with less confidence. It is a dwarf with very incompletely dissected fronds, short, acute segments or teeth, short and oblique false veins, and semicircular lips of the involucre. Except as to the last feature, its description is perfectly matched by Hooker specimens from Sikkim, and by Hooker and Thomson specimens from Khasia, all in the Gray Herbarium, and all with very acute lips. I am not reconciled to the reduction to *T. latemarginale* of plants with distinctively oblique, short false veins—*T. nanum* van den Bosch, *T. viridens,* and *T. palmifolium;* but if *T. nanum* is *T. Kurzii,* the other reductions follow naturally.

Trichomanes acuto-obtusum Hayata, Ic. Pl. Formos. 4 (1914) 135, from Bonin, is "near *T. Kurzii,* but separable from it by the short obtuse valves of the involucres," Hayata supposing *T. Kurzii* to have a truncate involucre. So far, it might obviously be *T. latemarginale,* and the false venulation is depicted as intermediate between oblique and parallel to the margin, partly one and partly the other. But the lip of the involucre is described and drawn as "eroso-denticulate." I have a specimen from Kwangtung, *Matthew 24,* on which a majority of the involucres are of this kind, but a few have evenly rounded lips. If there are distinct species in this group and region, this is one, having an inconspicuous longitudinal false veinlet between costa and margin. On the strength, however, of this evidence of the instability of the erose lip, I believe that *T. acuto-obtusum* should be reduced to *T. latemarginale.*

46. **TRICHOMANES MEGISTOSTOMUM** Copeland sp. nov. Plate 23, figs. 4 to 6.

Taschneria parva, T. Makinoi C. Chr., et T. viridanti Mett. simile, involucro statu naturae e basi attenuata sensim valde explanato labiis latis brevibus undulatis sicco praestantissime bilabiato ore quam tubo usque triplo latiore; rhizomate filiforme intricato; stipitibus 3 ad 5 mm longis laminam prope decurrenti-alatis; lamina 12 ad 15 mm longa, 8 ad 14 mm lata, sterile saepe adspectu digitata, fertile aut monopodiale aut irregulariter pinnatifida, plus minus more flabelli (sicca) contracta, segmentis 5 ad 8 mm latis, sicco adspectu acutis sed vero apice rotundatis; venulis spuriis sparsis plerisque brevibus vermifor-

mibus obliquis, rarius elongatis sinuosis longitudinalibus in ala solitariis; involucro in segmento subapicale frondis terminale, anguste alata, 1.6 mm longo, ore 1.2 mm lato, venulis spuriis (an semper?) carente.

Siam, *Md. Haniff* and *Md. Nur 3981*. Type in Herb. Singapore.

Obviously related to *T. nanum* van den Bosch, which, as *T. Kurzii* Beddome, I construe as a form of *T. latemarginale*. It may occasion surprise that, at the same time that I propose to reduce a considerable number of species in this group, I describe a new one. I construe as one species all of the forms which I believe to be within an unterrupted range of variability, but regard as distinct a form which seems to be without this range. The fact that its affinity is clear is no objection to its recognition as a species; in fact the commonest cause of difficulty in placing or recognizing species is that they were described without such knowledge.

The change in shape of the involucre, as it dries out, or conversely is soaked and restored in form, is accomplished by drawing together the sides (where the wings are attached) of the involucre, as it becomes dry, making the tube, in extreme cases, narrowly linear, in the plane in which it is commonly seen. In pressing a specimen, the involucre is commonly flattened in the plane at a right angle to the plane of compression in this case. Some contraction of the kind described here can be detected in other species of this group, and may be responsible for discrepancies of description; but I have never observed it in any comparable degree in any other species. It is illustrated in a measure by Plate 23, figs. 5 and 6, but these drawings were made from the same sorus in this sequence (wet, first) and the involucre was incompletely dry when the second was made. In the herbarium, the tube is commonly contracted to one-third the width of the mouth.

47. DIDYMOGLOSSUM LATEALATUM van den Bosch. Plates 25 and 26.

Didymoglossum latealatum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1863) 138.

Fronde plus minusve late lanceolata bipinnatifida, laciniis primariis erectis vel patulo-erectis subcontiguis (infimis divergentibus remotiusculis) secundariis patulis apice leviter recurvis remotis e basi lata apice 1–3 furcatis simplicibusve, lacinulis appressis anguste linearibus apice angustatis plicatulis margine undulatis, rhachi leviter flexuosa venisque (in axillis praesertim) latissime undulato-alatis, venulis angulo acutissimo exeuntibus longe procurrentibus, venulis spuriis plerisque elongatis 1–2 serialibus, submarginale nulla, cellulis teneris diaphanis irregulariter plus

minusve elongato-hexaëdris partim mediocribus, partim parvis, interaneis amorphis dilutis subparietalibus flavescentibus, parietibus hyalinis tenuibus, soris in laciniis primariis lateralibus secundariarum locum occupantibus exsertis, indusio inferne conico-tubuloso aequaliter angustato ima basi angustissime alato mediotenus bilabiato, labiis ampliatis rotundatis antice leviter porrectis, stipite ultra medium ala undulata angustate marginato 6–10 millim. longo. Rhizoma ultra setaceum repens parce ramosum fusco-tomentosum; frons 4–5 cent. longa, 12–16 millim. lata flaccida e viridi olivacea.

A praecedente [D. racemulosum] hanc distinguere suadent: forma frondis, latissima rhacheos ala, venulae spuriae elongatae biseriales, cellulae majores elongatae, indusium exsertum forma omnino diversa, etc.

Hab. India orientalis (Nepal), (Assam) GRIFFITH, H. HOOK.—Van den Bosch, loc. cit.

DIGEST OF VAN DEN BOSCH'S INDIAN DIDYMOGLOSSA [6]

DIDYMOGLOSSUM RACEMULOSUM, page 137.

Frond ovate or oblong-ovate, 3 to 5 cm long, 1.5 to 2 wide, stipe 1 cm long, narrowly winged, rachis narrowly undulate-winged, veins broadly winged, especially in axils; false veins few and short, none submarginal; involucre broadly winged (immersed), cut one-third of the way down into semicircular lips. Assam, *Griffith.*

DIDYMOGLOSSUM PLICATUM, page 139.

Fronds 5.5 to 7 by 3 to 4 cm; stipe 3 to 2.5 cm long, winged to the base; pinnæ and pinnules remote, segments plicate dry, undulate, acute; rachis narrowly winged; false veins short in two or three series, none submarginal; involucre winged, lips semicircular, one-third as long as the tube. More robust than others. Divisions subfastigiate, "folded like a fan." Malacca, *Griffith;* Ceylon, *Thwaites 2985;* (Sumatra?).

DIDYMOGLOSSUM GRIFFITHII, page 141.

Frond 3 to 4.5 by 1.6 to 2 cm; stipe 1 cm long, winged; rachis winged; one continuous, sinuous false vein near margin; sori immersed; involucre short, ventricose, mouth dilated, obscurely 2-lobed, lobes rounded, undulate. Mergui, *Griffith.*

DIDYMOGLOSSUM EUPHLEBIUM, page 142.

Frond 6 by 1 to 1.5 cm, rigid; stipe 2 cm long; pinnæ remote, segments narrow, acute; rachis narrowly winged; false veins many, short, in plural series, none submarginal; involucre immersed, subventricose, narrowly winged, lips shorter than tube, obtusely triangular. Assam, *Griffith.*

[6] Ned. Kruid. Arch. 5 (1863) 137–144.

DIDYMOGLOSSUM INSIGNE, page 143.

Frond 2.5 to 3 by 1 to 1.5 cm, flaccid; stipe 1 cm long, narrowly winged; rachis broadly winged; segments undulate, obtuse or emarginate; false veins few, short, conspicuous, in one or two series parallel to margin, but none submarginal; involucre small, immersed, broadly conic, with broadly rounded lips rather longer than tube. Mishmee, *Griffith.*

In an appraisal of these descriptions, two contrasting facts stand out; namely, first they seem to be excellent descriptions, and to distinguish the plants clearly and sufficiently; and second, on seven to nine collections from one general area, all from one herbarium (Hooker's) where they passed as conspecific, six new species are based. In a group remarkable in other lands for specific instability, this is not sufficient material to justify the opinion that the species are really distinct. The Gray Herbarium and the United States National Herbarium have about as many specimens in this group, from the Hooker herbarium, and I expected them to match the van den Bosch descriptions, so that I might know the species properly at first hand; but they do not match, even closely, except in a single instance. Beddome had Hooker specimens, and transferred two of van den Bosch's names to *Trichomanes,* as *T. plicatum* and *T. insigne.* Only these two of the van den Bosch names appear in the Gray Herbarium, and both of these match Beddome's interpretation. How far this is from conformity with van den Bosch may be seen by comparing my figure of the Gray Herbarium specimen of *T. plicatum,* Plate 25, fig. 2, which is sufficiently the same as Beddome's plate, Ferns Brit. India, pl. 285, with van den Bosch's statement that the lips are "semicircularibus tubo 3plo brevioribus crenulatis." *Trichomanes insigne* is the one instance of approximate conformity, and the false veinlets are not conspicuous in specimens seen. With this qualification, and the further one that the fronds may be 6 cm long and 4 cm broad, with narrowly winged rachis, I can apply this name to collections by Gustav Mann, August, 1888, from Shillong Peak, Khasia Hills, *U. S. Nat. Herb. 329769,* and from Sootyngia, Jaintia Hills, March, 1890. Less closely, I can identify other specimens as *T. plicatum* and *D. latealatum,* but if these van den Bosch species are really distinct, I seem to have twice as many more, presenting still different combinations of the same unit characters, and mostly still represented by one collection each.

I can make no decision without collections enough to provide a much better judgment on the stability of the forms. There is no reason that *T. bipunctatum* should not have as many related species as *Athyrium Filix-foemina* in this area. On the other hand, there is no a priori ground for assuming that *T. brevipes* and *T. bilabiatum* present the limit of possible specific instability. *Didymoglossum latealatum* may be still more unstable; and in the final synthesis, it may be *T. latemarginale*. In the latter event, the following species will fall into the same basket. The forms or species of this group, as far as I know them from China, fall within the range of the Indian specimens, and *T. Makinoi* is certainly one of this group.

48. **TRICHOMANES MAKINOI C. Christensen. Plate 27.**

T. Makinoi C. CHRISTENSEN, Index Fil. (1906) 644.
T. acutum MAKINO ex Christ, Bull. Herb. Boiss. 4 (1896) 665, non Presl.
T. Tosae CHRIST, Bot. Mag. Tokyo 24 (1910) 240.
T. bipunctatum OGATA, Ic. Fil. Japon. pl. 45, non Poir.

Espèce des plus originales; par sa fronde voisine de *T. pusillum* Sw., par ses organes fructifères voisine de *T. filicula* Bory.

Plante cespiteuse en gazon très serré, à rhizomes rampants, filiformes. Fronde glabre, membraneuse, très tendre, diaphane, vert-clair, longue de 2½ cm., large de 1½ cm., presque sessile, flabelliforme-obovée, triangulairement tronquée vers un stipe des plus courts, pinnatifide à large aile centrale, segments à bord onduleux, crispé, bifurqués à la pointe, quelquefois incisés latéralement jusqu'à une aile large, se terminant tous assez brusquement en pointe très effilée et mucronulée. Nervures fortes, une par segment, stries intercalées (*spurious veinlets* Hook.), peu accentuées. Urcéoles à peu près de la grandeur et de la forme de *T. filicula*, rares, terminaux, à segments surmontés d'une dent, brièvement pédonculés, ovales, s'élargisssant vers la moitié en deux lobes larges arrondis, un peu crispés denticulés au bord; réceptacle quelquefois dominant l'urcéole.

Tosa [Japan] Nov. 1887, 1. Makino; nom indigène *Kokehoragake*, non encore trouvé par M. Faurie.—Christ, Bull. Herb. Boiss. 4 (1896) 665.

Of this species I have from the Hong Kong herbarium a Makino collection, which I have supposed to be the type collection, but it is dated November, 1888. It is from Nanokawa, Tosa, and is typical, as is also a collection by Watanabe in the Gray Herbarium dated February, 1890. Collected at the same time and place, the Gray Herbarium has another sheet labelled *T. Filicula*, identical with one in *United States Nat. Herb. 223990*, dated 1894, and with others from other Japanese localities, similarly named. The Watanabe specimen of *"T. Filicula"* is most interesting because, along with oblanceolate fronds 4 cm long, responsible for the identification, it contains fronds of practi-

cally typical *T. Makinoi*, and any desired intermediate between these extremes, all on the same tangle of rhizomes. The false venulation is equally variable; most often, in elongate fronds, there are elongate, approximately longitudinal strands, in an irregular and broken series, farther from the margin than in *T. bipunctatum*. The segments vary from very acute to obtuse. The tube of the involucre is winged, broadly or narrowly. The lips vary from as broad as the tube to a half wider, from half as long as the tube to fully as long, and from rounded to triangular. In short, considering only specimens from the type locality, *T. Makinoi* varies in a degree comparable to that of *T. brevipes*, and through a range sufficient to include several of van den Bosch's species of *Didymoglossum*. Similar forms occur elsewhere in Japan, in Korea, and Formosa, and throughout China; but only the short forms with sharp tips have been recognized as *T. Makinoi*. *Hancock 137*, from Yunnan, is this species, with the charactertistic tips, but acute lips and almost no false veinlets. So, also, is *Taquet 3634*, from Korea, distributed as *T. capillatum*. So, too, I believe less confidently, is *Cavalerie, Ros. Fil. Chin. 42*, from Pinfa; and this identification of one of the Hooker collections from Sikkim, *United States Nat. Herb. 51139*, in the Gray Herbarium also, "J. D. H. 48," would be almost automatic if the specimen were from Japan.

Through such forms as *T. palmifolium*, *T. acuto-obtusum*, and *T. nanum* van den Bosch, the transition between *T. Makino*, and *T. latealatum* has only small gaps. In the other direction, the large and narrow forms of *T. Makinoi*, hitherto known by other names, effect the transition to such forms as were named by van den Bosch. The phyletic homogeneity of the group is certain.

8. HEMIPHLEBIUM

Minute plants with simple and entire or merely lobed fronds. As has been indicated in my general introduction, such extreme reduction in size as characterizes this group involves a simplification of structure, in the course of which the characteristics of an ancestral group may be lost. Evolutionary lines in which the salient change is one of simplification thus converge, almost of necessity. I am, therefore, in doubt as to the naturalness of a group characterized by minuteness and simplicity—which in effect are terms of negation. The species here included in *Hemiphlebium* have one common positive feature, the presence of false veinlets. Because of this one character, the group is construed as derived from *Taschneria*. It remains, however,

a pure assumption that these false veinlets are all homologous. Among themselves, they differ in various respects. Although they have been studied comparatively by Mettenius, Prantl, and Giesenhagen, and intensively by Geobel, the degree of their morphological identity seems to me to remain undecided.

The group, as here defined, is more than pantropic in geographical range, which casts doubt on its derivation, as a whole, from *Taschneria,* restricted to the Old World. It may be noted, too, that the name used, *Hemiphlebium,* is applied approximately as by Prantl, the group being more nearly the *Microgonium* of Presl.

Key to the species of Hemiphlebium.

False and true veinlets present; fronds not peltate.
- Without submarginal vein.
  - Without marginal hairs.
    - Fertile fronds narrow at base.
      - Sori immersed, usually plural.
        - Involucre tube elongate ..... 49. *T. sublimbatum.*
        - Involucre as wide as long..... 50. *T. henzaianum.*
      - Sori free ..... 51. *T. beccarianum.*
    - Base broad but not cordate.
      - Apex not notched ..... 51. *T. beccarianum.*
      - Sorus in an apical notch..... 53. *T. cultratum.*
    - Base cordate ..... 52. *T. Motleyi.*
  - Marginal hairs present.
    - Fronds lobed or divided..... 55. *T. montanum.*
    - Fronds entire or crenate.
      - Veins close, 2 to 5 cells apart..... 56. *T. exiguum.*
      - Veins remote, many cells apart..... 57. *T. Wallii.*
- Submarginal vein present.
  - Fronds slender, over 2 cm tall..... 60. *T. mindorense.*
  - Fronds broader and shorter.
    - Stipe about as long as the frond..... 62. *T. cuspidatum.*
    - Stipe short or none.
      - Tube of involucre slender.
        - Hyaline border evident under lens. 58. *T. bimarginatum.*
        - Hyaline border inconspicuous..... 61. *T. erosum.*
      - Tube not over twice as long as wide.
        - Tube cylindric ..... 59. *T. craspedoneurum.*
        - Tube obconic ..... 38. *T. rupicolum.*

False veinlets present; fronds peltate..... 53. *T. omphalodes.*

False veinlets wanting.
- Lateral veins present.
  - Stipe as long as width of frond..... 19. *T. barklianum.*
  - Stipe not over half as long as frond-width..... 24. *T. liberiense.*
- Frond veinless except for costa ..... 22. *T. vitiense.*

True veinlets absent, false veinlets present..... 63. *T. parvifolium.*

49. TRICHOMANES SUBLIMBATUM C. Müller. Plate 28, figs. 1 and 2.

Trichomanes sublimbatum C. MÜLLER, Bot. Zeit. 12 (1854) 737.

Rhizoma repens tomentosum; frondes distantes assurgentes unciam unam longae vel elatiores, tenuiter membranaceae pellucide virentes sordidae, spathulato-oblongae cuneatae breviter stipitatae, margine statu juvenali integrae, statu senili sinuato-emarginatae planae, vix lobatae, obtusatae; nervi primarii e medio nascentes dichotomi, secundarii interpositi *ad marginem e cellularum quadratarum serie unica neque vena limbatum* oriundi evanescentes; cellulae *firmae amplae fuscae parietibus crassis fuscis instructae, quadratae non hexagonae;* indusia ad apicem frondis immersa cuneato-oblonga apice infundibuliformia labio subreflexa; receptaculum breviter exsertum.

Tr. Hookeri Kze. Bot. Zeit. 1847 p. 300.—*Tr. muscoides* Hook. Sp. Filic. I. p. 117, planta Javanica, excl. syn. ceteris et diagnosi.—*Tr. marchantioides* Zip. ms. in Zollinger. Coll. Fil. Jav. No. 865 et 1899.—*Tr. muscoides* Zoll. Coll. No. 865.—*Tr. sublimbatum* Zoll. Coll. No. 3500.

Patria. Java: Zollinger.

A praecedente (T. Hookeri Presl, Hym. p. 16) notis cursivis literis expressis certe refugit.—Müller, loc. cit.

Aptly described in its well-developed form as spathulate-oblong. Smaller specimens, to be regarded as juvenile but sometimes fruiting, are oblong, with a broad base. Well developed, it is usually more lobed than as figured by van den Bosch, Hymen. Jav. pl. 2, and in gross appearance is like *T. montanum,* from which it differs in the more numerous false veins and absence of marginal hairs. It is larger and commonly more lobed than *T. bimarginatum,* and without a submarginal vein.

Assam, *Mann.* Tonkin, *Pételot.* The Peninsula; Sumatra; Java; Borneo; Papua.

Trichomanes papuanum Brause, Engler's Jahrb. 56 (1920) 32, is described as distinguished from *T. sublimbatum* by slender, naked rhizome and pale green color. I have not seen the type collection, *Ledermann 7835;* but naked, threadlike rhizomes and coarser, densely hairy ones can be found mixed, in Papua (*Zahn*) and elsewhere. The shade of green is variable in most or all species of the group, and *T. sublimbatum* is normally distinctly lighter than some of the species—*T. Motleyi,* for example.

50. TRICHOMANES HENZAIANUM Parish. Plate 28, figs. 3 and 4.

Trichomanes henzaianum PARISH, ex Hooker, Second Century of Ferns (1860) pl. 1.

Caudice filiformi repente ramoso parce nigro-tomentoso, frondibus parvis remotiusculis brevi-stipitatis obovato-subflabelliformibus membranaceis subnitidis laete viridibus vix semiunciam longis marginibus magis minusve irregulariter lobatis vix pinnatifidis lobis brevibus obtusis, venis apice liberis primariis paucis subflabellato-pinnatis satis distinctis, secundariis iis

parallelis arctis deliculatis venulis transversis junctis et ita frondibus minute reticulatis, involucris in lobis frondium venas primarias terminantibus omnino intramarginalibus textura frondis infundibuliformibus, limbo dilatato integro, stipite gracili vix lineam longo.

Trichomanes Henzaianum, *Parish in litt.*

HAB. Detected by *Mr. Henzai*, and the *Rev. C. S. P. Parish*, partially clothing the trunks of trees at Moulmein, 1859.—Hooker, loc. cit.

Distinguished from *T. sublimbatum* "Above all, by the involucre, of which the limb in *T. sublimbatum* extends to the margin of the frond, while in our plant, the lobe of the frond extends much beyond the involucre."—Hooker, loc. cit.

Hooker figured the venation correctly, except that the strands are not thickened at their apices. There are a few fairly conspicuous main veins, of which more than half—those reaching the upper part of the frond—may bear sori. Between them are numerous fine strands, "false veins," two to four parenchyma cells apart, nearly all running to the marginal row of cells, some free at the lower end, some connecting with the veins. There are no transverse veins or veinlets whatever, submarginal or elsewhere; the only possible interpretation of Hooker's "venulis transversis" is that he was seeing the walls of the parenchyma cells.

Hooker was, of course, again in error in describing the involucre as though its halves were different, one only being provided by the lamina. As in all relatives, and as follows from the method of growth, the two halves are alike; each is like the lamina in general, in the details of size and structure of the parenchyma cells, and in the strands. However, the appearance described by Hooker is real, and characteristic. Both halves are "over-full." As the plant grows, this may result only in the extreme dilation of the involucre; but in the herbarium, and even after specimens are softened, the overfulness results in a pleating and folding, whereby parts of the involucre appear short, whichever side be viewed.

The authentic specimen studied is in the Gray Herbarium, collected in Tenasserim by Parish, possibly a part of the type collection, as Moulmein and Tenasserim are not sure to be distinguished. Wherein it fails to fit Hooker's diagnosis, it agrees with his figure too well to permit doubt of its identity.

The rhizome is about $\frac{1}{2}$ mm in diameter. The stipes are spaced about 1 cm apart and are up to 1 cm in length. The fronds are 1 cm, more or less, in length, usually not so wide, and are mostly attenuate at the base. Some fronds are decided-

ly lobed. Rhizoids are sparsely present as far up as the lower third of the midrib. The parenchyma walls are 2 to 3 μ in thickness, or up to 4 μ near the margin; but the outer walls of the marginal cells are thin, or invisible. The superficial cells of the strands have likewise walls only 1 μ thick. The involucre is about 1.5 mm long and wide, with acute base and broadly undulate margin. There are no protruded receptacles in the material studied. The most similar species is *T. sublimbatum*, from which this differs in the form of the involucre, broad, and with straight sides in *T. henzaianum*, but with a slender, inflated tube in *T. sublimbatum*.

51. TRICHOMANES BECCARIANUM Cesati. Plate 29.

T. beccarianum CESATI, Atti Accad. Napoli 7 pt. 8 (1876) 8, pl. 1, fig. 2.

T. cognatum CESATI, Rend. Accad. Napoli 16 (1877) 24, 28, non Presl.

T. minutissimum v. A. VAN ROSENBURGH, Philip. Journ. Sci. § C 11 (1916) 102, pl. 5, fig. 1; GOEBEL, Flora 124 (1930) 397 et seq., figs. 11–19.

Stirps praecedenti [T. Motleyi] simillima crescendi modo et frondium dispositione, differt vero pluribus notis. Color (in sicco) magis glaucescens; frondes minores ovatae, vel oblongae, vel lineari-oblongae, nec cordato- orbiculatae, minus pellucidae, venis crebrioribus strictis i. e. rectilinee divergentibus, nec extrorsum curvulis ut in *Tr. Motleyi;* sori singuli apicales (vix uno vel altero in speciminibus praesentibus) breviores, sed quoque ore dilatato patulo integro.

Ad arborum corticem arcte applicatum.

Sarawak; 1866.—Cesati, loc. cit.

In its vegetative phase, this is a smaller and more delicate plant than *T. Motleyi*, but with distinctly more development of the costa. In typically vegetative fronds of the latter species, the veins are radiate almost from the base, a costa reaching half the height of the frond being present only in the minority which are to be regarded as representing a transition to the fertile phase. In *T. beccarianum*, a costa reaching half the height is the rule, and it is common for it to be more prolonged. The base, deeply cordate in *T. Motleyi*, is rarely cordate at all in *T. beccarianum*, commonly rounded or broadly cuneate on small, practically sessile fronds, more narrowly cuneate on many of the still sterile fronds. The fertile fronds are exceedingly variable in form, but distinguished from *T. Motleyi* by the narrow base. It is usually easy to distinguish the two species sterile, but sometimes difficult (*Ridley 323*, Singapore; and *Leiberg s. n.*, Luzon); fertile, it is always easy.

CEYLON, *Wall; Ferguson; Thwaites C. P. 3972* in part, part being *T. Wallii.* THE PENINSULA AND SINGAPORE, Ridley *10241,* and some unnumbered collections. BORNEO, *Beccari,* the type collection. JAVA, *Bakh. v. d. Brink 5931; Mousset 85.* CHRISTMAS ISLAND, *Ridley 85.* PHILIPPINES: LUZON, *Williams 463; Merrill 3523.* MINDANAO, *Clemens* λ; *Merrill 8321; Williams 2262.* PALAWAN, *Merrill 9492.* AMBOYNA, *Robinson 1944 partim,* the type collection of *T. minutissimum.* PAPUA, *Schlechter 14921.* The most of these collections were distributed as *T. Motleyi;* some, from the Philippines, under an herbarium name meaning "naked."

52. **TRICHOMANES MOTLEYI** van den Bosch. Plate 30, figs. 1 to 4.

Trichomanes Motleyi VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 145.

Microgonium Motleyi VAN DEN BOSCH, Hymen. Javan. (1861) 5, pl. 1.

Fronde subsessili adnata e cordato orbiculari integra subundulata, sterili avenia, venulis spuriis tenuibus remotiusculis, e cellulis teneris mediocribus regularibus acutangulis viridulis (marginalibus validioribus magis opacis) contexta, fertili costa simplici, soris e sinu apicali profundo subexsertis cylindrico-ventricosis limbo ampliato integro undulato, receptaculo vix exserto.

Hab. Insula Borneo (pr. Laboan), MOTLEY No. 203 (comm. ill. W. J. HOOKER).

Rhizoma setaceum dense atro-fusco-tomentosum; frons vix ultra 4 millim. longa et lata . . . venulae spuriae flebellatim radiatimve e basi frondis vel e costae basi marginem versus tendentes tenues remotiusculae apice libero ante seriem cellularum marginalium desinentes. . . .

. . . Habitu *Hemiphlebium punctatum* (POIR.) simulat adeo, ut oculis nudis vix ab illo distingui possit . . . Praeterea in illo *Hemiphlebio* adest costa manifesta frondisque margo setulis fasciculatis reflexes praeditus est.—van den Bosch, Hymen. Javan. (1861) 5. [The diagnosis in Ned. Kruid. Arch. is practically identical.]

Characterized, within its group, by stout axial structures and usually deeply cordate sterile fronds, thus being intermediate between *T. cultratum,* which is without the cordate base, and *T. omphalodes,* which has become peltate by the fusion of the basal lobes. These three species are collectively distinguished by broad fronds and stout, short, or obsolete stipes. Of the three, *T. cultratum,* as represented by its one collection, seems to be peculiar in the absence of hairs except near the base, the others being more or less hairy almost to the margin of the nether surface.

The type collection, as indicated, was from Borneo, and sent to van den Bosch by the elder Hooker. The Gray Herbarium contains a sheet of absolutely typical specimens bearing the notation "Borneo (ded. Hooker)," which can be regarded con-

fidently as a part of the type collection. It includes possibly two hundred fronds, almost all sterile. The mature ones are mostly 5 to 7 mm wide and a millimeter less in length. From the point of attachment to the apex is 4 mm or less; a costa may extend half of this distance or may be obsolete. The venation is in the latter case wholly flabellate; otherwise it is largely so. The marginal cells are slightly differentiated; their differentiation marking the cessation of growth of the frond. Short black hairs are then found on all veins, from the base almost to the margin.

The fertile fronds are, of course, costate. The base is truncate or very broadly cuneate, rarely shallowly cordate. The apex is cleft, commonly one-third of the depth of the frond, sometimes even more deeply. The sorus is sessile or short-stipitate (by the extension of the costa above the base of the cleft); it is about 2 mm long, with flaring but not really lobed lip.

I have perfectly typical material from Bukit Panday (as well as the label can be read) ex Herb. Singapore, 1905. With this exception, the many specimens labelled *T. Motleyi* are all smaller ferns with the base rounded, usually not at all cordate sterile fronds, and narrowly cuneate fertile fronds with longer and mostly slender stipes. If all one species, these should be called *T. beccarianum;* this applies to all specimens seen from the Philippines, Ceylon, Java, and New Guinea. *Trichomanes pannosum* Cesati, Rend. Accad. Napoli 16 (1877) 24, 28, seems by description to be *T. Motleyi.* As to the occurrence of *T. Motleyi* in Queensland, see Domin, Bibl. Bot. 20 (1914) 9.

53. TRICHOMANES CULTRATUM Baker. Plate 30, figs. 5 to 7.

Trichomanes cultratum BAKER, Journ. Bot. 17 (1879) 293.

Rhizome filiform, wide-creeping. Stipe very short. Lamina suborbicular, entire, ½ in. diam., glabrous, firm in texture for the tribe, the margin entire and naked, the base cuneate or rounded, the midrib distinct above the middle in the sterile fronds, in the deeply emarginate fertile fronds reaching to the deep apical sinus, and bearing a single free funnel-shaped involucre, with a large spreading two-lobed mouth. Receptacle not protruded. Veins radiating flabellately from the sides and tip of the midrib. Sori never more than one to a frond. On trunks of trees in shady woods of Bua, Vanua Levu, *Horne,* 1078! Closely allied to *V. Motleyi* V.D.B.—Baker, loc. cit.

The rhizome is filiform in fact, but stout in proportion to the size of the fronds, and everywhere densely covered with black hairs, as are also the short stipes. In the relative stoutness and hairiness of these axial structures this species is like *T. omphalodes* and *T. Motleyi,* in contrast with the slenderness of

these structures in *T. beccarianum* and *T. vitiense*. The mature fronds are mostly about 4 mm long and 3 mm wide, with the apex broadly rounded on sterile, cleft on fertile fronds. The base is usually obtuse or rounded but sometimes short-cuneate, especially on fertile fronds. The costa is rather stout, extending more than half the length of adult sterile fronds. The veins are few, those originating from the costa usually extending to the marginal cells. False veins are likewise few and commonly fall short of the margin. The sori are large in proportion to the fronds, about 2 mm long, and more than 1 mm wide at the top, flaring, but not really bilabiate.

The species has been known from the type collection only, but I am unable to distinguish by description *Trichomanes Sayeri* F. v. M. and Baker, Ann. Bot. 5 (1891) 195.

Rhizome wide-creeping. Stipe very short. Frond orbicular, or obovate-cuneate, ⅛–¼ in. long, deeply emarginate, with rounded apical lobes. Midrib distinct from base to apex; veins flabellate. Indusium solitary, terminal, stipitate; lips orbicular. Trinity Bay, Queensland, *Sayer*.—Baker, loc. cit.

The first publication of this name was in v. Muller's Second Census 230; the reference there to a still earlier publication is in error.

Domin, Bibl. Bot. 20 (1914) 9, says it is wide-spread in the Bellenden-Ker Mountains, epiphytic on tree trunks and rarely on moist rocks, altitude 100 to 200 meters.

54. TRICHOMANES OMPHALODES (Vieillard) C. Christensen. Plate 31, figs. 1 to 6.

Trichomanes omphalodes (Vieillard) C. CHRISTENSEN, Index (1906) 646.

Microgonium omphalodes VIEILLARD ap. Fournier in Ann. Sci. Nat. V 18 (1873) 255.

Trichomanes peltatum BAKER, Journ. Linn. Soc. 9 (1866) 336, pl. 8, C, not *T. peltatum* Poiret.

Frondibus imbricatis tenuiter membranaceis sessilibus peltatis suborbicularibus, venis et venulis spuriis flabellatim dispositis, involucris paucis inclusis, ore late dilatato.

Rhizome wiry, slender, wide-creeping, tomentose. Fronds quite sessile, attached to the rhizome near the centre or towards the base, suborbicular in general outline, half an inch to an inch and a half across each way, quite adpressed to the surface on which they grow . . . involucres cylindrical, coriaceous in texture, more or less exserted, with a very much dilated slightly two-lipped mouth.

SAMOA, July 1864, *Powell, 125*.—Baker, loc. cit.

I have seen this fern from Samoa, Tahiti, Rarotonga, Fiji, New Caledonia, New Guinea, Amboina (the type collection

of *T. minutissimum*), and Java (*Bakh. v. d. Brink 3340*). It has been reported from continental Asia, Formosa (Matsumura and Hayata, Enumeration 567), and Liu Kiu; but I mistrust these reports. It is reliably reported in Queensland.

It is at once a well-characterized and a variable species. Typically it is peltate, practically sessile, fixed near the center, and approximately orbicular, either nearly flat or with the center depressed, and overfull enough to be wavy of surface and with deflexed or moderately ruffled margin. The point of attachment is sometimes eccentric, rarely almost marginal. Growth, of course, begins at this point, and the form at any time depends on the uniformity of growth around the periphery. Growth is long-continued; even fruiting fronds sometimes have parts of the margin still active. The margin finally ceases growth, without becoming differentiated. The largest fronds seen, 25 mm in diameter, are from New Caledonia and New Guinea.

Main veins spring from the point of attachment. A few of these produce sori; the majority end just inside the margin. Between them are numerous strands or false veins, most of which are free at the inner end, and do not quite reach the margin. The parenchyma cells are in fairly regular radial rows, with walls 3 to 4 μ in thickness. The superficial cells of the strands are very thin-walled.

The tube of the involucre is "typically" immersed, 2 to 3 mm long and about 1 mm wide. Whether, when it is mostly or wholly free, this is the result of growth or of splitting, I do not know. The limb is 2 mm wide, often flat and orbicular, sometimes two-lipped in appearance, rarely really somewhat bilabiate. Very few of the sori examined retained any protruded receptacles, and these were short. The annulus is of about 23 thickened cells and about 4 thinner-walled ones forming an imperfect stomium.

55. TRICHOMANES MONTANUM Hooker. **Plate 31, figs. 7 and 8.**

T. montanum Hooker, Ic. Plant. (1837) pl. 187.
T. quercifolium Hooker and Greville, Ic. Fil. pl. 115, non Desv.
T. Robinsonii Baker, Journ. Linn. Soc. Bot. 9 (1867) 339, pl. 8, fig. B.

Frondibus oblongis basi attenuatis subsessilibus pinnatifidis, laciniis obliquis oblongis obtusis subsinuosis fructiferis terminalibus cuneatis, involucro exserto urceolato apice bialato, columna longe exserta.

Hab. . . . Esmeraldas, Colombia. . . .

I am not aware that this can be confounded with any known species of Trichomanes. . . .—Hooker, Ic. Plant., loc. cit.

Trichomanes quercifolium Hooker and Greville was described eight years earlier, from the same collection. *Trichomanes Robinsonii* was described from Natal specimens, but later reduced by its author to *T. pusillum*, along with *T. quercifolium*. As to *T. pusillum*, I am not sure, but believe that it has an immersed sorus. The Natal plant differs from the run of South American specimens in being smaller, and with less dilation of the lips of the involucre; however, the American specimens are not constant in either respect, and the identification is reasonable.

The fronds are 1.5 to 2 cm long, short-stipitate, dilated upward, and there more or less deeply and irregularly pinnately lobed. The margin is beset with clustered dark hairs, likely to be appressed. False veinlets are present, but not very numerous, nor conspicuous. The involucre is narrowly winged, and strongly bilabiate.

56. TRICHOMANES EXIGUUM (Beddome) Baker. Plate 32, figs. 1 and 2.

Trichomanes exiguum (Beddome) BAKER, Syn. Fil. (1874) 464.
Hymenophyllum exiguum BEDDOME, Ferns of Brit. India (1868) pl. 275.

Rhizome creeping pilose, stipes about 1–2 lines long, pilose at the base, fronds ¼ to ½ an inch long by 1–2 lines broad linear-oblong entire or slightly repand at the margin, veins pinnate from a central costa simple or forked, spurious venules few but nearly as prominent as the veins not reaching the costa and often not touching the margin, never anastomosing; involucre solitary terminal the base sunk in the frond, valves entire large and spreading receptacle exserted or included.

Hab. On trees in dense forests (3–4,000 feet elevation) Wynaad and Coorg.

Some of the fronds are furnished round the margin with minute brown hair-like appendages, . . .—Beddome, loc. cit.

I know this species only from Ceylon specimens: ex Herb. William Ferguson, in the United States National Herbarium and the Gray Herbarium, the latter fine and ample; and from another sheet in the Gray Herbarium, *Beckett 2364*. The last was (presumably, but without number) cited by Beddome in the notes following his diagnosis, and is thus authentic.

The rhizome is hardly 0.2 mm in diameter, and bears very short hairs. The fronds may be densely imbricate because the rhizomes interlace, but on the single rhizome they are spaced,

either separate or slightly imbricate. The short stipe is still more slender than the rhizome. The sterile fronds are 3 to 5 mm long, broadly ovate, subcordate-rounded at the base, rounded at the apex, obscurely crenulate at least in the upper part. The black marginal hairs are the most conspicuous characteristic. These are single or paired, or sometimes clustered, and easily broken off. The costa is evident well toward the apex of the frond; the lower parts of it and of the lower veins bear hairs on the nether surface. The fertile fronds are more slender than the sterile, and are broader above, instead of at, the base. The tube of the involucre was described as partly immersed. In the limited material seen, I find it wholly immersed; or half immersed, with or without a broad wing on the upper part; or only one-quarter immersed—all on fronds shown to be uninjured by the presence of marginal hairs near the sorus. The involucre is 1.5 mm long, with a flaring mouth 1 mm wide, somewhat plicate in the herbarium and apparently bilabiate—whether or not really so, I am in doubt. The receptacle is long enough to be seen, but is hardly excurrent.

Trichomanes Giesenhagenii C. Christensen, Index 641 [*T. microphyllum* Giesenhagen, Flora (1890) 439, pl. 14, fig. 2], known to me only by description and figure, must be very like *T. exiguum*, which was evidently unknown to Giesenhagen. It is described as larger, about 7 mm long, and with many false veinlets. It is to be noted that he regarded any vein without vascular tissue as "false," while I use the term only for those strands which are not connected with the costa, whatever their composition.

Habitat, Joanna Island, in the Comores. Found mixed with *T. cuspidatum*.

57. **TRICHOMANES WALLII** Thwaites. Plate 32, figs. 3 to 5.

Trichomanes Wallii THWAITES ex Trimen, Journ. Bot. 23 (1885) 274.

Fronds simple, ¼ to nearly ⅜ in. long, mostly broad-ovate, with a cordate base and very obtuse apex; margin minutely and distantly denticulate; venation subradiate, the midrib being distinct, but lost before reaching the apex of the frond; no spurious venules; involucres solitary, terminal, not placed in a sinus, and not or very slightly exserted beyond the margin of the frond; border of mouth flat, spreading, entire.

Hab. Stones and tree-trunks in the stream running through the Labugama Elephant Kraal, March, 1870, collected with masses of *T. muscoides* by Mr. W. Ferguson (C. P. 3989 in Herb. Perad.). Rhizome very slender; fronds not crowded, subsessile.

Very near *T. Motleyi* V. de B., and perhaps not more than a variety of it, but distinguishable by the sunken not exserted involucres. The shape of the fronds varies; the ones bearing fruit are less cordate, or even tapering at the base.

The name *T. Wallii* Thw. has been published in Mr. W. Ferguson's pamphlet, 'Ceylon Ferns' (Columbo, 1880), preface, and in Mr. G. Wall's 'Check List.'—Trimen, loc. cit.

Baker, Ann. Bot. 5 (1891) 194, published an independent diagnosis, in which may be noted: "Frond ovate or orbicular, ciliated, entire, $\frac{1}{8}$–$\frac{1}{6}$ in. long. . . . Indusium funnel-shaped, immersed, with a broad entire collar-like border."

Of this, I have in hand specimens ex Herb. William Ferguson from the United States National Herbarium and the Gray Herbarium; although without "C. P." numbers, these may represent the type collection. The Gray Herbarium specimen of *C. P. 3972*, "Trichomanes Henzaiense Bedd.," consists of two strips of bark well covered with minute *Trichomanes*. One is *T. beccarianum*, the other *T. Wallii*. As *T. henzaiense* (Hook.) was only a misprint of *T. henzaianum*, it should be ignored as a name; it was figured from a Burma specimen.

Trichomanes Wallii was apparently intended to be distinguished from *T. exiguum* by the more completely immersed tube of the involucre, and by the absence of false veinlets. As the degree of immersion is altogether inconstant in *T. exiguum*, this distinction does not hold; also, it is inconstant in *T. Wallii*. Neither are false veinlets wanting in *T. Wallii*—they are only unusual; on some fronds I detect a single veinlet failing to run down to the costa.

Judging by the material seen, *T. Wallii* is much more lax in venation than is *T. exiguum*, the veins or false veinlets being separated by only two to four or five rows of laminar cells in the latter, by ten or more rows in the former. I do not know that this or any other distinction between them is really constant.

Trichomanes paradoxum Domin, Bibl. Bot. 20 (1914) 10, pl. 2, fig. 4, is known to me only by its description and picture; it seems to differ from *T. Wallii* in having a more hairy margin, and repeatedly forked veins; there is no mention of false veinlets, but Domin could have overlooked them as easily as Baker did. Whether or not the two species are identical, they are very similar. I have suspected the presence of *T. Wallii* in Borneo, having a specimen without label, which seems likely to have been Bornean.

58. TRICHOMANES BIMARGINATUM van den Bosch. Plate 33, figs. 1 to 4.

Trichomanes bimarginatum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 143; Journ. Bot. Néerl. 1 (1861) 346; DOMIN, Bibl. Bot. 20 (1914) 11, pl. 3, fig. 2.

Microgonium bimarginatum VAN DEN BOSCH, Hymen. Javan. (1861) 7.

T. yandinense BAILEY, Syn. Queensland Fl. (1883) 686.

T. bimarginatum; T. muscoides Brack. p. 249 (*non alior.*) in WILKES expl. exped. XVI p. 249. Fronde breviter stipitata e basi cuneata oblonga vel obovato-oblonga, fructifera apice angustata, margine integro repando undulato, costa flabellatim in venas simplices furcatasve abeunte, interpositis venulis spuriis in venulam submarginalem confluentibus, cellulis diaphanis magnis regularibus elongato-hexaëdris pachydermis amoene viridibus globulosis, marginalibus dissimilibus majoribus abbreviatis 3–4edris, soris mediocribus immersis, indusio cylindrico longe angustato, sursum in limbum amplum undulatum subito dilatato, stipite complanato dense fusco-tomentoso 4 millim. longo. Frons vix ultra 1½–2 centim. longa, 6–8 millim. lata.

Hab. Ins. Ceylon: THWAITES no. 2986; Ins. Fidchi: WILKES.—Van den Bosch, op. cit. 143.

From the "preliminary publication" in Hymenophyllaceae Javanicae, I would regard the Ceylon specimen as the type; it and the Fiji plant are perfectly identical. The fronds are elliptic, oblong or obovate, with either rounded or cuneate base. The false veins are numerous and conspicuous, as are also the submarginal vein in which the others terminate and the single row of hyaline marginal cells. The fronds may be entire, in which case the tube of the involucre is immersed; or cleft or irregularly but not deeply lobed, in which case the sori occupy lobes, and the appearance is rather that of being broadly winged than of being immersed involucres.

Ceylon, the Peninsula, Papua, New Caledonia, Fiji, Samoa, Queensland. Probably common but too small to be conspicuous. This wide-spread species may be regarded as the type and probable parent of a subgroup, of which *T. cuspidatum, T. erosum, T. mindorense,* and *T. craspedoneurum* are local or outlying representatives.

59. TRICHOMANES CRASPEDONEURUM Copeland. Plate 33, figs. 5 to 7.

Trichomanes craspedoneurum COPELAND, Philip. Journ. Sci. 7 (1912) Bot. 53.

Rhizomate filiforme repente; stipitibus brevibus vel subnullis, minute pilosis; fronde 1 ad 1.5 cm longa, oblanceolata, integra vel saepius paucilobata, deorsum angustata et pilifera, sursum glabra; venatione pinnata, venis spuriis obliquis sat conspicuis, cum vena submarginale anastomosantibus; soro solitario apicale, tubo cylindrico omnino immerso, limbo dilatato, cum margine anastomosante et deinde bilabiato.

LUZON, Province of Tayabas, Infanta, alt. 100 m, *J. B. Leiberg*, sheet No. 593183, U. S. Nat. Herb.

Distinguished from *T. sublimbatum* K. Müll, and *T. henzaianum* Hooker by the evident submarginal vein. Near *T. Petersii* A. Gray of Alabama.—Copeland, loc. cit.

Nearly related to *T. bimarginatum*, but with distinctly fewer false veins and broader involucre.

60. TRICHOMANES MINDORENSE Christ. Plate 34, figs. 1 and 2.

Trichomanes mindorense CHRIST, Philip. Journ. Sci. 3 (1908) Bot. 270.

Vicinum T. neilgherrensi Bedd., a quo discrepat venulis spuriis nullis, fronde lateraliter lobata, textura crassiuscula, opaca.

Nanum caespitosum, rhizomate ramoso intricato tenui minuto squamuloso brunneo, foliis confertis numerosis dense caespiticiis, sessilibus, 1.5 cm longis, 2 ad 3 mm latis, aut simplicibus anguste lanceolatis versus basin longe attenuatis obtusis, aut lateraliter et in apice lobatis, lobis 1 ad 4, 1.5 mm longis, rotundato-ovatis, obtusis, costa manifesta nigra, nervis obliquis manifestis 6 ad 8 utrinque, simplicibus, ad marginem protensis, nervulis spuriis nullis, margine linea tenuissima cincto. Basi foliorum setulis brunneis vestita, planta aliter nuda. Soris in apice terminalibus omnino immersis subreniformi-dilatatis vix 1 mm latis, ore non prominente angusto, receptaculo interdum longe exserto. Colore brunneo-viridi opaco, textura adiaphana crassiuscula.

MINDORO, Binabay River, *Merrill 6006*, November, 1906.—Christ, loc. cit.

Although most of the items in the diagnosis are applicable to individual fronds, the species is a tenable one, distinguished from *T. bimarginatum* by the extreme slenderness of the fronds. The rhizome is very slender, hardly 0.2 mm in diameter, or apparently thicker because of its felt of hairs. The space between fronds is commonly 5 to 8 mm. The stipe is usually about 1 mm long, sometimes 2 to 5 mm. It is hairy, but the costa is naked except at its base.

The fronds are about 2 cm long, rarely simple, and then hardly 2 mm wide; usually they bear one to several lobes in the upper part and may there reach a width of 4 to 6 mm, over all. The base is very attenuate. The margin is sometimes entire, in which case the veins are unbranched, as described; or it may be sinuate, with the protruding wave often supplied with a forked vein; my drawing shows more of these than are usual. As to false veins—such as do not connect with the costa—Christ was in error. Very few of these are evident with a simple lens, but greater magnification always shows some very small scattered ones, as well as a break at the bottom of some of those which with the lens seem connected with the costa. The intramarginal strand is like that of *T. bimarginatum*, but the radial veins are less numerous.

The tube of the involucre is very slender, about 2 mm long, and immersed—that is, broadly winged throughout. The mouth is abruptly dilated, 1.3 to 1.5 mm wide, not at all bilabiate; it is traversed by radial strands like fine false veins. Protruding receptacles 2 mm long are common in the material studied.

The ample type collection of this species has never been exactly duplicated. *For. Bur. 19599 H. M. Curran,* Cagayan Province, Luzon, is referable to it, but deviates in the direction *T. bimarginatum.* Its fronds are 2 to 2.5 mm wide when unlobed, and there is a correlated tendency for the veins to be close, forked and free, and toward a less acute base.

61. TRICHOMANES EROSUM Willdenow. Plate 34, figs. 3 to 6.

Trichomanes erosum WILLDENOW, Sp. Pl. 5 (1810) 501.

T. frondibus stipitatis oblongis erectis cuneatis irregulariter pinnatifido-incisis, laciniis inaequalibus obtusis undulatis. W. Ausgenagter Becherfarrn.

Habitat in Oware *et* Benin Africes. ♃ (*v. s.*) *D. Flügge.*

Caudex *filijormis repens crassitie setae equinae.* Stipes *quadri- vel quinquelinearis filiformis.* Frons *longitudine stipitis vel parum longior erecta oblonga, basi cuneata, pinnatifido-incisa, laciniis inaequalibus obtusis subrepandis undulatis.* Sorus *versus apicem frondis indusio urceolato inclusus.*— Willdenow, loc. cit.

Without a specimen, but depending apparently on a figure published by Palisot de Beauvois, van den Bosch, Synopsis 15, classified this as having "venulae spuriae, secus marginem junctae." Immediately afterward, Ned. Kruid. Arch. (1863), he described on page 200 *T. crispulum,* said to be from the Antilles, very similar to *T. erosum,* with the submarginal vein, and stipe of varying length, up to 8 mm long; and on page 201 *T. aerugineum,* from Fernando Po, subsessile, with false veins ending free within the margin. Both of these were promptly reduced by the usually careful Kuhn, Filices Africanae (1868) 34, to *T. erosum,* wherein he has been followed by Hooker (teste Baker, Syn. Fil. 75—but all of them further reduced to *T. muscoides* Sw.) and Christensen.

My material does not justify a judgment. If they are indeed all one species, varying enough to include the two of van den Bosch, it should include the specimen from Liberia, the subject of Plate 34, figs. 3 to 6, which I have accordingly called *T. erosum.* In what might be expected to be specific characters, it differs from Willdenow's description only in having a short stipe.

62. TRICHOMANES CUSPIDATUM Willdenow. Plate 32, figs. 6 and 7.

Trichomanes cuspidatum WILLDENOW, Sp. Pl. 5 (1810) 499.

T. frondibus ovatis acuminatis obtusis stipitatis, basi cuneato-subtruncatis, grosse crenatis undulatis. W.

Zugespitzter Becherfarrn. W.

Habitat in insula Borboniae. ♃ (*v. s.*) *D. Flügge.*

Stipes *quadrilinearis compressus setis paleaceis parvis obsitus.* Frons *pollicaris vel brevior ovata vel oblonga, basi cuneata vel truncata, apice attenuata obtusa, margine profunde et obtuse crenata undulata, membranacea, nervoso-venosa, apicem versus et margine fructificans.*—Willdenow, loc. cit.

Better described, as well as pictured, as *T. Bojeri,* by Hooker and Greville, in Icones Filicum II (1831) pl. 155.

Trichomanes *Bojeri;* fronde simplici flabelliformi membranacea radiatim nervosa glabra lobata, lobis rotundatis subcrenatis soriferis, involucris omnino immersis, stipite elongato.

* * * * * * *

Stipites unciam ad sesquiunciam longi. . . .—Hooker and Greville, loc. cit.

Of this species I have seen a single collection, made by Mrs. Nicholas Pike, in Mauritius, in 1869, *U. S. Nat. Herb. 593139.* The venation is that of *T. bimarginatum,* from which the naked eye distinguishes it by its long stipe. Both rhizome and stipe are glabrescent. The fronds vary from roundish to narrowly oblong, 25 mm long by 7 mm wide. The base is as described by Willdenow, truncate, broadly cuneate, or narrowly decurrent. The venation is flabellate in broad forms, but there is a weak costa in narrow fronds. The fertile lobes vary in width. When they are narrowest, the lamina is a wing only a few cells wide along the upper half of the tube of the involucre.

Unknown except from the Mascarenes, and rarely collected there.

63. TRICHOMANES PARVIFOLIUM (Baker) comb. nov.

Hymenophyllum parvifolium BAKER, Journ. Linn. Soc. Bot. 9 (1866) 340, pl. 8, fig. E.

Trichomanes miorophyllum KUHN, Linnaea 35 (1868) 389.

Frondibus lineari-oblongis indivisis vel uni- vel bifurcatis, costa centrali sola, venis lateralibus nullis, venulis spuriis liberis, involucro solitario incluso, ore late alato.

Rhizome slender, wide-creeping, tomentose. Stipes a line long or less, naked or slightly tomentose. Frond two or three lines long by a line broad, linear-oblong, undivided or once or twice cleft at the apex, sometimes slightly, sometimes nearly halfway down, with a central costa only, which runs down the centre of each lobe when the frond is divided; lateral veins none, but marked with faint irregular free spurious venules; the margin slightly undulated, glabrous; the sorus solitary, terminal; the involucre globose-triangular, narrowed into the costa, about as deep as the convex broadly rounded valves.

Moulmein, *Rev. C. Parish,* 1862.—Baker, loc. cit.

Rhizoma capillare arrhizum; folia distantia, membranacea, laete viridia; glaberrima, 1–3‴ longa, brevi petiolata, lanceolato-oblonga, indivisa,

bi- trifida; lobis brevi-oblongis s. oblongis, obtusis, apice emarginatis; costa excurrens s. more laminae divisae; nervi spurii striaeformes, obliqui, pauci nec costam nec marginem attingentes; sorus laminam terminans basi cuneata immersus; labiis triangulari-ovatis.

Moulmein. (Parish 1862. in Herb. Hook.)—Kuhn, loc. cit.

I dislike to change the name without seeing the plant, but there is no doubt that it is a *Trichomanes*. It may represent the final stage in the reduction of *T. latemarginale*.

9. THE GROUP OF TRICHOMANES RADICANS

Large ferns, with coarse, scandent or creeping rhizomes and decompound fronds, simple and uniform cell structure, the walls uniformly if at all thickened; involucre cylindrical, and not strongly bilabiate. In the Tropics and mild-temperate regions of both hemispheres. Throughout the group, the fronds tend to be dark.

This group links the large-leaved elements of the genus to the presumably more primitive element with filiform rhizomes; and the single species *T. radicans* fairly covers, in the matter of size, the range from typical *T. pyxidiferum* to the largest-leaved species.

Besides the species herein recognized or explicitly reduced to synonymy, there are two, *T. Fargesii* and *T. Miyakei*, to which I am unready to do either; their original descriptions are quoted, following the discussion of the species known to me.

Key to the species.

Frond simply pinnate ..... 72. *T. auriculatum.*
Frond decompound.
  Mouth of involucre ciliate ..... 71. *T. superbum.*
  Mouth not ciliate.
    With abortive fronds at base of normal fronds. 69. *T. aphlebioides.*
    Without abortive fronds.
      Rachis winged.
        Axes of pinnules winged as narrowly as segments.
          Involucre evidently bilabiate..... 68. *T. johnstonense.*
          Not or hardly bilabiate..... 67. *T. maximum.*
        Pinnules less deeply dissected.
          Fronds deltoid, long-stalked..... 66. *T. cyrtotheca.*
          Fronds elongate.
            Frond almost black ..... 65. *T. davallioides.*
            Frond green or dark green..... 64. *T. radicans.*
      Rachis wingless ..... 70. *T. giganteum.*

64. TRICHOMANES RADICANS Swartz. Plate 35, figs. 1 and 2.

T. radicans SW., Schrader's Journ. Bot. (1800) 97; Fl. Ind. Occ. 3 (1806) 1736; HOOKER, Sp. Fil. 1: 125.
T. speciosum WILLD., Sp. Plant. 5: 514.
T. anceps WALL., Cat. No. 166, nomen, non Hooker.
T. birmanicum BEDD., Ferns Brit. Ind. Suppl. 3, pl. 349.
T. japonicum FR. and SAV., Enum. Pl. Jap. 2 (1879) 207, 618.
T. orientale C. CHRISTENSEN, Index (1906) 646; OGATA, Ic. Fil. Jap. pl. 47.
T. naseanum CHRIST, Soc. Bot. Fr. Mém. 1 (1905) 11; OGATA, Ic. Fil. Jap. pl. 46.
T. liu-kiuense YABE, Bot. Mag. Tokyo 19 (1905) 35; CHRIST, Bot. Mag. Tokyo 24 (1910) 239.
T. amabile NAKAI, Bot. Mag. Tokyo 28 (1914) 65.
T. quelpaertense NAKAI, Bot. Mag. Tokyo 28 (1914) 66.
T. kalamocarpum HAYATA, Ic. Pl. Formos. 5 (1915) 260, fig. 93.

TRICHOMANES, frondibus alternatim tripinnatifidis, laciniis bifidis obtusis, urceolis exsertis; stipite rachique marginatis; surculo scandente. Incolit arbores montium *Jamaicae*.

* * * * * * *

Frondes sparsae, *stipitibus* 1–3-pollicaribus teretibus a foliolis decurrentibus marginatis s. subulatis; pedales, ovato-lanceolatae, subtripinnatae, saturate virides, glabrae, subpellucidae. *Raches* universales partialesque marginatae . . .

Urceoli fructificationum subpedicellati, quasi exserti, prope axillas laciniarum, cylindracei, ore membranaceo patulo. . . .—Swartz, Fl. Ind. Occ. 3: 1736.

In citing synonyms, I have confined myself to the Orient, including *T. speciosum*, described from Teneriffe, because many Oriental specimens have been given this name. A fern has to be variable to be named anew so many times. In Jamaica, the type locality, the fronds are commonly 15 to 25 cm long and broadly ovate, but smaller fronds can be fertile; the stipe is usually short, but varies from one-fifteenth of the frond's length to as long as the frond, and may be broadly winged throughout, or wingless except near the top. Throughout the American (continental) Tropics, the common form or variety, once called *T. kunzeanum*, averages larger and more dissected than does any Oriental form. Going north to Alabama, while fronds may be 20 cm long, 8 cm is commoner, and the outline lanceolate-ovate; and from the extreme limit of the species, in Kentucky, our fronds are less than 5 cm long; but nobody questions that these are real *T. radicans*.

The range in size and in dissection of the Oriental forms I reduce to *T. radicans* is not as wide as that already familiar in this species in America. It is granted that the duplication of Oriental forms by American forms which cannot be maintained as distinct species, does not quite disprove the specific nature of the Oriental forms; but the fact is that the forms I have reduced are not distinguishable in the Orient, either. It is worth while to note that the authors of the most generally recognized of the species I have reduced, *T. japonicum* Fr. and Sav. (*T. orientale* C. Chr.), distinguished it from *T. radicans* by its greater size, their *T. radicans* being just such a reduced form as represents the same species at its extreme north in the United States and in France. Subsequent authors of "new species" have located them as intermediate between *T. orientale* and *T. radicans*, meaning thereby that they were larger than *T. orientale* and, as a rule, correspondingly dissected. Such species are no sooner recognized than their range is found to be very wide, because *T. radicans* is plastic locally, as well as in a wider geographic sense. If *T. orientale* were a species, its name would be *T. birmanicum*.

In its ample forms, *T. radicans* is likely to have fronds 30 cm or more long on rather short stipes, and to be shallowly tripinnatifid with the larger segments cleft. It is constantly distinguishable from *T. maximum* by the undissected middle area of its pinnules; the texture is less firm, but both are typically very dark in color; and the rhizome is beset with persistent dark bristles. The stipe and rachis are usually evidently, sometimes broadly winged; but the wing may disappear very completely after being present, and be wanting from the start on the lower part of the stipe. The involucre is tubular, variable in length, stalked, sessile, or somewhat immersed at the base, almost truncate or considerably dilated at the mouth, and commonly slightly cleft at the sides or more evidently, but still not conspicuously, bilabiate.

In consideration of its range in stature and dissection, and of its geographical range, it is reasonable to regard this species as connecting the groups and species with large fronds and the groups with filiform rhizomes, the latter being regarded as the more primitive element of the genus. It is more than possible that in the reduction of species I have not gone far enough—that forms of *T. radicans* more reduced than I have recognized as such still remain in the group of *T. pyxidiferum*.

Western Africa; northern India, China, Korea, the Japanese Islands, south to Formosa, Indo-China (*Pételot 3605, et al.*), and Siam (*Winit 936*, in Herb. Singapore). There is also one collection, *Yates 71*, from Sumatra-East Coast, which seems to be a large form of this species, with almost sessile fronds.

65. TRICHOMANES DAVALLIOIDES Gaudichaud. Plate 36.

T. davallioides GAUDICHAUD, in Freycinet, Voy. Bot. (1826) 378.
T. sandvicense VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 165.

T. Frondibus sparsis, lanceolatis, bipinnatis, subtripinnatis, pedalibus; pinnulis lanceolatis, pinnatifido-dissectis; laciniis oblongis, obtusis, apice bi- vel trifidis; soris oblongis, axillaribus, subpedicellatis; rhachi stipiteque marginatis; caudice scandente, villoso.

In insulis Sandwicensibus (Wahou . . .).

. . . Grimpe jusqu'au Sommets des arbres. . . .—Gaudichaud, loc. cit.

A very common fern, often collected; in hand from Kauai, Oahu, Molokai, Maui, and Hawaii. It is well described by Hillebrand, Flora of the Hawaiian Islands 636, except for his statement that it is quite uniform. He says also that the stipes are ½ to 5 inches long, which gives a better idea of its uniformity. The rhizome is freely scandent, 1.5 to 3 mm in diameter, densely beset with short hairs, tardily glabrescent, the fronds separated by less than their own width. The fronds reach a length in excess of 40 cm. They are lanceolate, oblong or ovate, commonly broadest about the middle, but subsessile ones may be truncate at the base. The axes are narrowly winged. Well-developed, fully fruiting fronds are four times pinnatifid, with segments hardly 1 mm wide, and the axes of the pinnules winged only to the same width; less dissected forms are also common. The color is a very dark green, sometimes nearly black. The laminar cells have uniformly thin, straight or curved, not wavy walls. The sori are cylindrical, 2 to 2.5 mm long, flaring at the mouth, often appearing bilabiate in pressed specimens, but not really so.

This is very near to the West Indian *T. radicans* Sw. Since it has no other equally near relative in the whole Pacific area, it is reasonable to regard it as descended from immigrants from America. It is the only Polynesian *Trichomanes* apparently of American origin.

Trichomanes sandvicense van den Bosch was described from a Wilkes Expedition specimen with very short stipes. The Wilkes specimens in the United States National Herbarium are three sheets, with many fronds, some (*51169*) conforming to van

den Bosch's description, some (*51170*) of the more typically developed, more dissected form; all are certainly one species.

66. TRICHOMANES CYRTOTHECA Hillebrand. Plate 35, figs. 3 and 4; Plate 37.

Trichomanes cyrtotheca HILL., Fl. Haw. (1888) 636.

Rhizome climbing as in no 3 [*T. davallioides*], wooly with crisp reddish-brown thin translucent hairs of many articulations. Stip. at distances of 1–3′, terete or most faintly margined, 2–4′ long, fibrillose in the lower portion. Frond polystichoid, ovate to ovate-lanceolate, 5–9′ × 3–7′, broadest at the base, firm chartaceous, dull brownish when dry, bi-, tripinnatifid, the rhachis very narrowly margined, often only in the axils, and faintly fibrillose. Primary pinnae 10–14 on a side, stipitate, ascending, ovate to ovate-lanceolate, the longest 2–4½′ long with a short acumination, pinnatifid at acute angles in the upper portion, but pinnate to a faintly margined rhachis nearer the base. Secondary segments or pinnules ascending, narrow ovate-oblong, obtuse, the lowest with a cuneate base and substipitate, their margins cut halfway or more into narrow oblong or obovate lobes which are sharply 2—5-toothed at the top. Veins close, forking, each lobe or segment with 2–9 branches, a few dark striae in the intervals between them. Invol. tubular, slender, about 1″ long, with an expanded bilabiate mouth, *curved*, truly axillary, terminating the first superior veinlet of a lobe, rarely 2 or 3 to a lobe, quite free, stipitate, the thickened tube brown, the lips green. Columella about the length of the tube.

Oahu: in the woods of *Kahuku* and *Kahana*.—Hillebrand, loc. cit.

A relative of *T. davallioides*, distinguished by the deltoid, clear green or olive-green fronds, comparatively wingless axes, and fewer segments. I do not find the curved or flexed sorus constant; Hillebrand emphasized this feature, comparing the species with *T. obscurum*, *T. elongatum*, etc., to which it is not nearly related. It is like *T. davallioides* in structure, except that in specimens examined the walls are not quite so thin. It seems much less variable than *T. davallioides*, and I do not believe that this appearance is dependent upon our having fewer specimens. The stipe is always elongate, approaching the length of the blade, and slender.

From Maui, I have *Faurie 106*, *111*, *113*, *434*, and *435*. In the Gray Herbarium is a Maui specimen collected by *E. Barclay*. In the United States National Herbarium are *Bartch 65*, *68*, *73* and *86*, all from "Hillebrand's Glen," near Honolulu, Oahu. "Waiane V.," the source of *Rock 1150*, is presumed to be in Oahu. Christensen, Bishop Mus. Bull. 25: 7, reports it from Hawaii.

Faurie 106 in University of California herbarium, received from Doctor Rosenstock as *T. davallioides* f. *dilatata* Ros., is in part *T. davallioides*, but includes one very large frond so diverse in the color and dissection of different parts that I believe it must be a hybrid, of the chimæra type.

67. **TRICHOMANES MAXIMUM** Blume. Plate 38, figs. 1 to 4.

Trichomanes maximum BLUME, Enum. (1828) 228; VAN DEN BOSCH, Hymen. Javan. 25, pl. 18.

T. fronde tripinnata ovato-oblonga amplissima, pinnis subalternis oblongo-lanceolatis, pinnulis cuneato-oblongis partito-pinnatifidis, laciniis subdichotomo-partitis, secundariis linearibus subbifidis, rachi omnino alata, stipite elongato inferne teretiusculo glabro.

OBS. Maxime affine *Trichomani meifolio*, Bory et Willd., quod differt frondibus multo minoribus et rachi setosa.

Crescit ad pedem montis Burangrang Javae insulae.—Blume, loc. cit.

Rhizoma validum pennam anserinam crassum horizontale radiculoso-ramosum, ramis parce ramulosis pilis brevibus atris hirsutis; stipites itidem validi approximati, basi terete setis atris hirsuti, hinc teretes illinc canaliculati usque 2½–3 decim. longi apice lineis breviter decurrentibus marginati; frons 2½–4½ decim. longa, 1½–2 decim. lata firma membranacea subopaca olivaceo-viridis ovata vel late ovato-oblonga tripinnatifida vel decomposita . . . .—Van den Bosch, loc. cit.

A species well characterized in general by the scandent rhizome and the large, dark, lax fronds of fairly firm texture, so divided that the axes of the pinnules are winged only to about the width of the segments. This dissection of the pinnules is the most convenient means of distinction from the large forms of *T. radicans*. Besides this, *T. maximum* is more likely to lose the pubescence of the rhizome, is commonly a decidedly larger fern, of firmer texture, and the involucre is not usually at all bilabiate, nor even indented at the sides.

In detail, it is variable, though less so than *T. radicans*. As in that species, the wing of the rachis and stipe may disappear; it may be wanting on the lower or the larger part of the stipe, or may run to the base. The wing of the involucre may be conspicuous or almost wanting. The mouth may be practically truncate, as is common in the Philippines; or slightly dilated, as is usual in Java; or moderately flaring, as in Polynesia; but none of these forms is locally quite constant. The more dilated involucre in the eastern part of the range narrows the gap toward *T. johnstonense*.

Common at lower and middle altitudes in all Malay islands; north to Siam and Formosa; eastward without interruption to Tahiti; and reported in Queensland.

68. **TRICHOMANES JOHNSTONENSE** Bailey.

Trichomanes johnstonense BAILEY, Proc. Royal Soc. Queensland 1 (1884) 14, pl. 1 (or 2).

Rhizome long, creeping, rigid, knotted, clothed with black bristle-like scales. Stipes somewhat angular, scarcely winged, 2 to 4 in. long, of a dingy brown color, the immediate base scaly as the rhizome. Fronds bipinnate

with deeply pinnatifid or bipinnatifid pinnules, 3 to 6 in. long, 1½ to 4½ in. broad, the rhachis slightly winged, the linear segments very narrow, 1-nerved. Indusia few on the lower lateral segments of the pinnule, free, erect, much tapering towards the base, the orifice two-lipped. Receptacle exserted usually long. Hab. Johnstone River. W. R. Kefford.—Bailey, loc. cit.

This is pictured, without detail, by Domin, Bibl. Bot. 20: 18, 19, who reports it as common in places in Queensland, and observes:

Eine charakteristische Art, die jedoch auf den ersten Blick von den sehr kleinen Formen des *T. maximum* schwer zu unterscheiden ist. Sie ist aber noch viel kleiner, die langkriechenden, rigiden Rhizome sind mit schwarzen Spreuschuppen dicht bekleidet, die Spreite ist höchstens 15 cm lang, die Röhre kurz zweilippig.

Das typische *T. maximum* besitzt dagegen ein starkes, beinahe kahles Rhizom, die Spreiten sind 30–75 cm lang, das Indusium am Ende verbreitet, aber nicht zweilippig.

Bailey's figure is apparently a "lithogram." Domin's is a much-reduced photograph of an herbarium sheet.

I have not seen this plant. Every detail by which Domin would distinguish it from *T. maximum*—size, hairy rhizome, bilabiate involucre—would make it *T. radicans*. Bailey's figure indicates more resemblance to *T. maximum* in the dissection of the pinnules, and does not show the secondary rachises to be winged.

Previously known in Queensland only. By description, I identify as this species a Fiji specimen, *Parks 20196a*. It could be a depauperate *T. maximum*.

Knowing this species by description only, I cannot satisfactorily distinguish from it a fern of the central Philippines which has been distributed several times as *T. speciosum* and as *T. pyxidiferum*. I prepared a diagnosis in 1908, but am still unready to publish a name for it. The description follows.

Rhizomate repente, ca. 1 mm crasso; stipitibus 5 ad 8 cm altis, sursum rhachisque anguste alatis; fronde 10 ad 18 cm alta, lanceolata, tripinnatifida; pinnis oblongis vel ovatis; segmentis ultimis 1 mm latis, ca. 5 mm longis, acutis sed sub lente emarginatis, integris, glabris, venis spuriis carentibus; indusii tubo 2 ad 3 mm alto, anguste cylindrico, alato, oro dilatato et bilabiato; receptaculo exserto.

The nearest affinity is to *T. maximum*, in spite of the details of description, which would bring it nearer to *T. radicans*.

NEGROS, Mount Canlaon, *Copeland 2074, Merrill 8028;* Horn of Negros, *Elmer 9878, 10268*. LUZON, Sorsogon, *Bur. Sci. 23549*

Ramos, Elmer 16185, 16937. LEYTE, *Bur. Sci. 15262, 41480 Ramos.* CAMIGUIN DE MINDANAO, *Bur. Sci. 14808 Ramos.* MINDANAO, Surigao, *Wenzel 3444, 3446.* BASILAN, *Bur. Sci. 16201 Reillo,* in part.

69. TRICHOMANES APHLEBIOIDES Christ. Plate 38, figs. 5 to 8.

Trichomanes aphlebioides CHRIST, in C. Chr., Index (1906) 635; HOLTTUM, Journ. Mal. Br. Roy. As. Soc. 6 (1928) 18, pl. 4.

T. tenuissimum CHRIST, in Schumann and Lauterbach, Fl. deut. Schutzgeb. in der Südsee (1901) 106, non van den Bosch.

T. pulcherrimum COPEL. in Philip. Journ. Sci. 9 (1914) Bot. 227.

Species maxima, valde composita, laciniis tenuissimis insignis, a *T. apiifolio* Sw. repente frondibus non caespitosis stipiteque setis rufis destituta, rhizomate a *T. maximo* Bl. laciniis valde regularibus tenuissimis textura tenera, a *T. giganteo* Bory laciniis multo angustioribus, a *T. ericoidi* Hedw. cui laciniis tenuibus proximum stipite haud setoso-tomentoso, statura multo majore, textura tenera indusioque margine magis dilatata diversum, rhizomate duro pennae gallinaceae crassitie, repente scandente flexuoso inferne glabrato apice setis nigricantibus parce vestito; frondibus sparsis, stipitibus vetustis remanentibus, frondiferis 15 cm longis firmis erectis nigrescenti-viridibus infra parce pubescentibus, fronde 40 cm longa, 20 cm lata deltoideo-ovata quadri- seu quinquepinnata, pinnis remotis, infimis brevioribus 12 cm longis petiolatis e basi latiore ovato-acuminatis versus apicem decrescentibus apice frondis caudato-acuminato; pinnulis valde regularibus ovato-triangulis, iterum pinnatis, pinnulis III ordinis in lacinias regulares angustissimas, et laciniis infinis saepe iterum partitis; laciniis ultimis vix ½ mm latis, 3 mm longis, filiformibus, nervo uno alaque angustissima sub lente solummodo recognoscenda constitutis, setulis minimis raris adspersis. Soris ad basin superiorem pinnularum III ordinis positis, brevissime hispidulis, pedunculatis anguste et cylindraceo-urceolatis saepe incurvis, margine horizontaliter dilatata conspicua, receptaculo modice exserto.

Kaiser Wilhelmsland: Sattelberg. . . . 300–900 m. . . . (Lauterbach n. 494 . . .).—Christ, in Schumann and Lauterbach, loc. cit.

A species of remarkable beauty, rivaling *T. apiifolium* in grace, and even exceeding it in size, characterized by its stout, scandent rhizome, the abortive fronds in the axils of the normal fronds, the finely dissected fronds with exceedingly numerous segments and the tubular involucres with flaring mouth.

Stipes up to 20 cm long; fronds up to 60 cm long and 30 cm wide, usually broadest above the base; rachis very narrowly winged; pinnæ short-stalked, ovate-lanceolate, acuminate, contiguous or imbricate; pinnules ovate, obtuse; secondary pinnules pinnatifid to a narrow wing into simple or cleft segments about 0.5 mm wide, the wing on the lower axes being even narrower than on the segments; nerves fine; texture thin, surfaces sparsely clothed with minute, club-shaped trichomes; laminar cells with

with deeply pinnatifid or bipinnatifid pinnules, 3 to 6 in. long, 1½ to 4½ in. broad, the rhachis slightly winged, the linear segments very narrow, 1-nerved. Indusia few on the lower lateral segments of the pinnule, free, erect, much tapering towards the base, the orifice two-lipped. Receptacle exserted usually long. Hab. Johnstone River. W. R. Kefford.—Bailey, loc. cit.

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thin, straight walls; involucre cylindrical, with narrow or obsolete wing and conspicuously flaring mouth, 2 mm long in Papua, slightly shorter in Sumatra and Fiji; receptacle long-exserted, but slender and fragile. The abortive fronds, one or two in the axils of each stipe on strongly developed plants, are commonly about 5 cm long, and destitute of lamina (under the naked eye), consisting essentially of the rachises and costæ.

JOHORE, *Ridley*, in 1892. MENTAWI, *Exped. Mentawei 195*. SUMATRA, *Boden Kloss 14516, 14831, Brooks 26*, type of *T. pulcherrimum*. SULA, *Atys 265*. CERAM, *Posthumus 2060*. TERNATE, *Bequin 3351*. PAPUA, *Bamler 55, Rosenstock Fil. Novo-guin. 179, Brass 1041, 1471, Kärnbach 68* as *T. bauerianum, King 193, Lam 570, 1212, Lauterbach 494* (type), *Schlechter 16854, Werner 61*. FIJI, *Parks 20295A*.

It seems hardly credible that so showy a species, ranging from Fiji across Sumatra, and common at least in places, eluded detection until 1900, but I have been unable to recognize it as any earlier species.

70. TRICHOMANES GIGANTEUM Bory.

Trichomanes giganteum BORY ex Willd., Sp. Pl. 5 (1810) 514; HOOKER, Ic. Pl., pl. 702.

T. frondibus triplicato-pinnatis, pinnulis pinnatifidis decurrentibus, laciniis linearibus inferioribus bifidis, superioribus obtusis emarginatis, rachi primaria tereti, secundaria alata. W.

T. frondibus decompositis, stipite canaliculato. *Bory in litt.*

* * * * * * *

Habitat in unica sylva ad lacum magnum insulae Borboniae *in arborum truncis.* ♃. (*v. s.*)

Caudex *crassitie pennae repens tomentosus.* Stipes *quadripollicaris teres canaliculatus glaber.* Frons *sexpollicaris, saepe vero pedalis et longior, circumscriptione oblonga vel lato- lanceolata, triplicato-pinnata.* . . . Rachis *primaria teretiuscula lineis duabus decurrentibus setis tenuissimis valde raris articulatis patentibus instructa; secundaria margine foliaceo alata.* . . .—Bory and Willdenow, loc. cit.

I have no authentic specimen of this species, and feel sure that the wide range which has been ascribed to it, including Malaya and Fiji, is due to confusion with other species. However, there is in the Gray Herbarium a specimen collected by Perrottet in Pondicherry which conforms perfectly to the description. It is distinguished from others of the immediate group by wingless stipe and rachis. The stipe is 13 cm long, the frond more than 40 cm. In dissection and texture it suggests *T. apiifolium*. The involucres are narrowly tubular, sessile but hardly immersed at

the base, moderately dilated but not bilabiate at the mouth. With as much certainty as is ever possible in the identification of *Trichomanes* by description, this is *T. giganteum*.

Specimens from Sikkim, collected by Hooker and Thomson, in the Gray Herbarium, and *Clarke 36382* in the United States National Herbarium, differ from it in having less deeply dissected pinnules and acute segments, but are like it (and unlike *T. radicans*) in having wingless stipe and rachis.

It is not impossible that it bears abortive fronds which have been overlooked.

71. TRICHOMANES SUPERBUM Backhouse. Plate 39.

Trichomanes superbum BACKHOUSE ex Moore in Gard. Chron. (1862) 44, non van den Bosch (1863).

T. hispidulum METTENIUS in Kuhn in Linnaea 35 (1868) 389.

T. ignobile CESATI, Atti Accad. Napoli 7 [s] (1876) 9.

Caudex thick, very short, creeping, chaffy. Fronds triangular-ovate, 2 to 3 feet high, and 1 to 1½ foot wide, tri-quadripinnatifid, dense, deep green, clothed beneath with minute translucent glandular hairs; ultimate divisions short, linear obtuse. Stipes tall, erect, rigid, *margined to the base with a very broad and rather undulated wing*, and like the rachides densely clothed with rough reddish hairs. Involucre subcylindrical supra-axillary, very small, the base sunk in a deflected segment; mouth not spreading nor two-lipped. *Backh. MS.*

This is a Bornean plant, and a very fine one certainly. It is of robust habit with broad triangular plane broad pinnuled fronds, having some resemblance to those of T. Prieurii, and is moreover remarkable for the very broad and well-marked wing which is continued down to the base of the stipes. This noble species was brought to England by H. Low, Esq., jun., and is in the collection of Mr. Day, as well as in that of Messrs. Backhouse.—Moore, loc. cit.

While this description agrees imperfectly with that of *T. hispidulum* by Mettenius, and applies incompletely to that plant, the salient characteristics conform so far that I cannot doubt the identity of the subjects. It is not credible that there is in Borneo another species with notably large deltoid-ovate fronds with hairy rachises and glandular-hairy lamina, and a conspicuously winged stipe, distinct from *T. hispidulum*, and not collected during the past seventy years. The rhizome is erect or ascending, not creeping in the usual sense even if casually prostrate; and no *Trichomanes* has a chaffy caudex.

The most striking feature of the species, at least of well-preserved specimens, is the ciliate mouth of the involucre, crowned by a showy fringe of erect trichomes. A similar feature recurs in *T. blepharistomum* of northern Luzon, to which the resem-

blance in other respects is not close. The laminar cells are notably large, with wavy lateral walls, oblique in places, and uniformly thin—that is, not pitted unless by fine pores.

Trichomanes ignobile was described from sterile material. Microscopic examination of a fragment of the type, showing the characteristic laminar hairs and wavy walls, has established its identity beyond question.

This species is known in Borneo, the Malay Peninsula, and Sumatra, and is too clear-cut to need citation of collections.

TRICHOMANES FARGESII Christ.

Trichomanes Fargesii CHRIST, Bull. Soc. Bot. Fr. Mém. 1 (1905) 10.

Rhizomate indefinite crescente flexuoso ebeneo, pilis rufis vestito postea glabrato funiformi late scandente, frondes numerosas alternas confertas biseriatim emittente, 65 cm. (et ultra forsan) longo, foliis numerosis sessilibus ovato-deltoideis acuminatis 10 cm. longis, 4 cm. latis versus basin latissimis sive paulisper attenuatis, tripinnatifidis, rachi, alata, pinnis pectinato-confertis oblongis obtusis, 1,5 cm. longis, 5 mm. latis costa alata, pinnulis circa utroque latere, profunde dichotomis aut flabellatim furcatis lobis linearibus uninervatis vix 1 mm. latis obtusis, tota fronde pilis longis rufis ciliata.

Urceolis creberrimis solitariis et terminalibus in lobis pinnularum inferioribus positis breviter pedunculatis (pedunculo alato) 1 mm. longis et latis in furca nervi prominuli positis aperte campanulatis ore patente, receptaculo crasso 5 mm. longo exserto. Egregium Chinae decus.

Hab. Su-tchuen or.: distr. Tchen-kéou, 1400 mètres, août, *Farges* 202.—Grimpant sur les rochers humides.

Splendide espèce du port de *Tr. brachypus* Kze, d'Amérique. Distingué par la fronde étroitement partagée, l'urcéole courte, largement ouverte et le réceptacle très long et raide.—Christ, loc. cit.

TRICHOMANES MIYAKEI Yabe.

Trichomanes Miyakei YABE, Bot. Mag. Tokyo 19 (1905) 34.

Rhizoma horizontale repens rigidulum tomentosum. Stipes erectus 10–15 cm. longus glaber sursum anguste alatus. Frons 15–27 cm. longa, 7—11 cm. lata, oblongo-lanceolata stricta flexilis bipinnata.

Pinnae I ordinis alternatae remotae ovato-oblongae acutae (nec acuminatae) 3–7 cm. longae 3 cm. latae basi subinaquilaterales cuneatae. Pinnae II ordinis rhombeo-oblongae v. ovato-oblongae 1½—2 cm longae 1–1½ cm. latae alternatae bipinnatifidae. Lacinulae lineares 1 mm. latae (in sicco angustiorae) 2–3 mm. longae apice obtusae saepe emarginatae unicostatae membranaceae laete virides glabrae, e cellulis uniformibus mediocribus oblongis contextae. Rachis anguste alato-marginata. Sori in pinnis secundariis axillares pauci; indusium anguste alatum cylindricum limbo recto subangustato. Receptaculum longissime exsertum 7 mm. longum.

Hab. Formosa: Rahau, in jurisdictione Taipe, legit K. Miyake.

T. caudato affine, a quo pinnis remotioribus laminis viridibus nec atroviridibus differt.—Yabe, loc. cit.

72. TRICHOMANES AURICULATUM Blume.

Trichomanes auriculatum BLUME, Enum. (1828) 225; OGATA, Ic. Fil. Jap. pl. 198.

Cephalomanes auriculatum VAN DEN BOSCH, Hymen. Jav. 34, pl. 25.

T. dissectum J. SM., Journ. Bot. by Hooker 3 (1841) 417 nomen; HOOKER, Sp. Fil. 1:140; BEDDOME, Ferns Brit. India pl. 182 (details bad).

T. fronde pinnata lineari-lanceolata glabra, pinnis alternis cuneato-oblongis obtusis basi sursum auriculatis deorsum abscissis multifidis, laciniis truncatis denticulatis, rachi submarginata subpubescente, caudice scandente radicante.

Crescit in Javae rupibus montanis.—Blume, loc. cit.

Rhizoma validum pennam gallinam crassum longissimum teretiuscolum flexuosum parce ramosum scandens, hinc glabrescens, illinc tomento fusco densissime vestitum . . . sori in lobulis pinnarum angustatis abbreviatisque lateralos semiimmersi, indusio mediotenus fere anguste marginato cylindrico plerumque incurvo vix conspicue ventricoso . . . cellulae tenerae diaphanae parvae, imo mediocres . . . parietibus hyalinis rectis modice incrassatis.—Van den Bosch, loc. cit.

A well-defined species, recognizable by the stout, long-scandent rhizome and simply pinnate fronds. The stipes vary from obsolete to 2 cm long. The fronds are up to 40 cm long and 5 cm wide, commonly 25 cm long and 3.5 cm wide, acuminate; rachis narrowly winged; pinnæ dilated on the upper side at the base, whence the name, acute to broadly rounded at the apex, irregularly incised, sometimes shallowly, sometimes well toward the costa, forming toothed lobes; sori, in full fruit, on both sides of the pinnæ; involucre truncate or notched on the sides, slightly dilated at the mouth in Java and the Philippines, more so farther north, narrowly winged in Java and the Philippines, more evidently so in China and India, broadly in some Japanese specimens.

Java, Sumatra, Malay Peninsula, common; Borneo. New Guinea, *Bamler 27.* Philippines, common; *Cuming 159,* the type collection of *T. dimidiatum* Presl and *T. dissectum* J. Sm., is typical enough *T. auriculatum.* Southern China; Himalayas from Assam to Northwest provinces; Formosa, Loo Choo, Onsima (*Wright*), Japan.

10. THE GROUP OF TRICHOMANES GRANDE

Terrestrial species with erect caudex and long, fascicled stipes; rachis and upper part of stipe normally narrowly winged, but the wing often caducous; fronds quadripinnatifid, with linear but not setaceous segments, bearing clavate trichomes; veins fine; cellu-

lar structure simple and uniform, with small cells, and thin, straight walls.

Three similar species common over the Malay-Polynesian area, long confused with the *T. rigidum* group and with *T. maximum*, and related to the latter.

Key to the species.

Mouth of involucre more or less dilated, naked.
Frond narrowly ovate ..... 73. *T. grande.*
Frond round-ovate ..... 75. *T. intermedium.*
Mouth of involucre truncate and ciliate..... 74. *T. blepharistomum.*

73. TRICHOMANES GRANDE Copeland. Plate 40, figs. 1 to 4.

T. grande COPELAND, Philip. Journ. Sci. 6 (1911) Bot. 70.
T. millefolium PRESL, Hymen. (1843) 135?; VAN DEN BOSCH, Hymen. Javan. 27, pl. 20; non Desvaux (1827).
T. anceps var. β HOOKER, Sp. Fil. 1 (1846) 135, pl. 40C, fig. 3.
T. elatum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 177, non Forster (1786).

Rhizomate erecto, stipitibus confertis, alatis, 20 cm altis; fronde 20–35 cm alta vel ultra, 10–15 cm lata, quadripinnatifida, rhachibus alatis, sparse puberula; segmentis ultimis 0.5 mm latis, planis, obtusis; soris paratactis, indusio utroque latere subcarinato, infundibuliforme, limbo dilatato et interdum subrevoluto.

Philippines: *Copeland 1739* (type) . . . Papua. . . .

This was included with some other species in *T. anceps* Hooker. *T. millefolium* Presl was based on another plant, also included in *Cuming 162*, which is *T. maximum* Bl. This is more like *T. rigidum* Swtz. which however is a much smaller plant, less divided, with shorter indusium, and is very doubtfully present in the Orient.

The Papuan specimen has much broader pinnae than those of the Philippines; . . .—Copeland, loc. cit.

Presl's *T. millefolium*, was described with "Rhizoma lineam crassum, repens, flexuosum, glabrum, lignosum," which if accurate must apply not to this plant but to *T. maximum*. The only specimen cited was *Cuming 162*, of which all the specimens I have seen have an erect rhizome and fascicled stipes. The same collection typified Hooker's *T. anceps* var. β, and was cited by van den Bosch, following a Sumatra specimen, in the publication of his *T. elatum*. The long failure of this common low-country fern to receive a tenable name is not more remarkable than the variety of species with which is has been confused. To correct the errors which must have entered herbaria by the distribution of misnamed specimens, I will cite such collections, the

names in parenthesis being those of the distribution; if no such name is given, the name distributed was *T. maximum.*

PHILIPPINES: *For. Bur. 1242, 1768 Borden, For. Bur. 2421 Meyer* (*T. meifolium*); *Whitford 274, 440, 720, 1604* (*T. rigidum* and *T. millefolium*); *Copeland 204* (*T. rigidum* and *T. maximum*); *Merrill 3115; Topping 435, 446, 715, 811; For. Bur. 8893 Curran; Matthew* (*T. millefolium*); *Merrill, Phil. Plants 632* (*T. bauerianum*); *For. Bur. 9540 Curran* (*T. rigidum*); *Bur. Sci. 6849, 9327, 9352, 9488 Robinson; Elmer 9050* (*T. bauerianum*); *Copeland 2008; Bur. Sci. 13096 Foxworthy and Ramos; Bur. Sci. 3133 Mearns; Bur. Sci. 22071 Ramos* (*T. rigidum*); *Bur. Sci. 10289 McGregor* (*T. radicans* and *T. bauerianum*); *For. Bur. 6774 Merritt* (*T. rigidum*); *For. Bur. 12086 Merritt; Merrill 6060; Elmer 9933; Bur. Sci. 18500 McGregor* (*T. rigidum*); *Wenzel 259* and *Bolster 344* (*T. rigidum*); *Bolster 269* (*T. apiifolium* and *T. bauerianum*); *For. Bur. 9317 Whitford and Hutchinson; Copeland 1671* (*T. obscurum*); *Micholitz s. n.; Wilkes Exped. 18* (*T. maximum* and *T. anceps* β). JAVA, *Bache 8827; Raciborski s. n.; B. v. d. Brink 4198.*

The Papuan plant referred to in the publication of *T. grande* is to be referred rather to *T. intermedium.*

74. TRICHOMANES BLEPHARISTOMUM Copeland sp. nov. Plate 41.

T. terrestre frondibus fasciculatis magnis, quadripinnatifidis segmentis linearibus pilis clavatis aspersis, involucris cylindricis alatis truncatis ore more T. superbi ciliatis, aliter T. grandi omnino simile.

LUZON, Cagayan Province, Kilingkiling River, *Bur. Sci. 79659 Edaño,* type in herb. Copeland *14440;* also *Bur. Sci. 79655, 79656 Edaño; Bur. Sci. 7560, 7569, 14548 Ramos; Weber 1558,* all from Cagayan. BATAN ISLAND, *Bur. Sci. 80338 Ramos.* All distributed as *T. rigidum* or *T. grande.*

The club-shaped trichomes are deciduous, leaving no certain trace on old specimens; but these can still be distinguished from *T. grande* by the truncate, tubular, winged involucre. Without fruit, the two are not distinguishable.

Judging by the name, this seems likely to be *T. thysanostomum* Makino, nomen nudum—nomen nudum not because published in Japanese, but because not described in any language. What is said about it is translated for me by a Japanese as, "This little fern, commonly called kashu in the Liu Kiu Islands, I identified previously as *T. apiifolium* Presl, but afterward found that this was an error."

75. TRICHOMANES INTERMEDIUM van den Bosch. Plate 40, fig. 5.

Trichomanes intermedium VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 179; Journ. Bot. Néerl. 1 (1861) 361, non Kaulfuss, nomen nudum.

T. Harveyi CARR., Flora Vitiensis (1873) 344.

T. maximum var. *grandiflora* ROSENSTOCK, Fedde's Repert. 5 (1908) 371.

T. intermedium (*T. anceps* β BRACK. (non Hook.) *in Wilkes* Expl. Exp. XVI *p.* 258), Fronde e basi cuneata latissime rotundatâ cordato-ovata decomposita, laciniis primariis e basi erecto-patula mox divergentibus recurvisque imbricatis late oblongis acuminatis (summis lanceolatis) tripinnatifidis, secundariis patulo-divergentibus remotis (infimis imbricatis, summis distantibus) e cuneato oblongis apice productis bipinnatifidis, tertianiis subpatulis infimis contiguis, sursum sensim magis remotis oblongis linearibusve pinnatifidis, ultimis remotis anguste linearibus elongatis, lacinulis angustis brevibus strictis apice subrecurvis, rhachi venisque teretibus anguste alatis, cellulis opacis firmis parvis minimisque subelongato-hexaëdris, parietibus fere inconspicuis rectis, interaneis amorphis spissis obscure fuscis, marginalibus minimis subtetra-semihexaëdris, soris in laciniis ultimis axillaribus exsertis mediocribus, indusio anguste cylindrico leviter ventricoso, subito in limbum amplum (tubo ter latiorem) undulatum subreflexum dilatato, stipitibus fasciculatis, e rhizomate brevi adscendente polyrrhizo, ultra medium anguste alatis 10–15 centim. longis. Frons usque 2½ decim. longa, basi 2–2½ decim., medio 18 cent. lata rigidiuscula angustissime membranacea olivacea.

. . . Inter *T. maximum* et *T. Millefolium* medium . . .

Hab. Ins. Fidchi Oualao), WILKES.—Van den Bosch, Ned. Kruid. Arch. 5 (1861) 179.

It seems not to have occurred to van den Bosch that this species and his *T. elatum*, described two pages earlier, needed to be distinguished, but they are really so near together that aberrant fronds of each completely simulate the other. Under the microscope, they are alike; but the difference in frond form holds with reasonable constancy throughout the area occupied by each species. *Trichomanes intermedium* has relatively wide fronds and relatively long stipes. Less constantly, the branching of *T. intermedium* is more divaricate, so that, according to the varying ampleness of the fronds, they are either more lax or have the pinnæ and pinnules more imbricate; the angle is more uniform, making the fronds more symmetrical; and the dilation of the mouth of the involucre is usually greater.

PAPUA, *King 351; Lam 815; Werner 51; Rosenstock, Fil. novoguin. 7; Brass 1040* (as *T. grande*). FIJI, *Brackenridge 18;*[10]

[10] The Wilkes (U. S. Exploring) Expedition numbers are publication numbers; thus, this "No. 18" refers to all collections given the same name, from Tahiti (?), Samoa, Fiji, and Luzon.

Horne 72; Prince; Parks 20137, 20190, 20224, 20228, 20294, 20295 in part, *20420* (all as *T. Harveyi*); *Gillespie 2202, 2636.* SAMOA: *Brackenridge; Powell; Graeffe; Betche; Prince; Reinecke 43a* and *b; Safford 49, 958; Setchell 218.* Most collections distributed as *T. maximum.* Reported from Tahiti by Brackenridge, and a specimen in the United States National Herbarium is so labeled; but I suspect confusion as to its source.

11. THE GROUP OF TRICHOMANES APIIFOLIUM

Caudex erect or suberect; stipes and rachises terete, conspicuously bristly; fronds large, thin, quadripinnatifid with narrow but not filiform or setaceous segments; cells with uniformly thin walls. Typically epiphytes. Geographical range, Malaya across Polynesia.

Key to the species.

Fronds normally more than twice as long as wide.
- Involucre truncate, obconic.
  - Involucre narrowly winged ..... 76. *T. apiifolium.*
  - Involucre broadly winged ..... 77. *T. bauerianum.*
- Involucre subbilabiate ..... 78. *T. polyanthum.*

Fronds normally less than twice as long as broad ..... 79. *T. Baldwinii.*

76. TRICHOMANES APIIFOLIUM Presl. Plate 42, fig. 1.

T. apiifolium PRESL, Hymen. (1843) 108 (nomen), 136; VAN DEN BOSCH, Hymen. Jav. 26, pl. 19.

T. eminens PRESL, Hymen. (1843) 108.

T. myrioplasium KZE., Bot. Zeit. 4 (1846) 477.

T. exaltatum BRACKENRIDGE, U. S. Expl. Exped. 16 (1854) 259.

T. meifolium BLUME, HOOKER, et al., non Bory.

T. bauerianum BAKER, C. CHRISTENSEN, et al., non Endlicher.

T. fronde glaberrima oblongo-lanceolata acuta tripinnata, pinnis linearioblongis pinnulisque anguste oblongo-lanceolatis petiolulatis acutis, secundariis anguste linearibus obtusis, infimis subbifidis, soris exsertis pedicellatis, indusii turbinati ore truncato, receptaculo setaceo indusio duplo longiore, stipite tereti rachibusque villoso, primaria apice secundariis tertiariisque alatis, rhizomate crasso lignoso obliquo frondes aggregatos gerente.

Cuming pl. exs. philip. n. 137 *et n.* 190.

Habitat in insulis philippinis, verosimiliter in insula Luzon, ubi legit clar. Cuming.—Presl. loc. cit.

Presl's detailed description may be omitted, as it applies to ill-developed specimens. He described the plant in its full development as *T. eminens.*

Caudex ascending or erect, the apex immersed in reddish-brown bristles commonly 5 mm long, bearing a mass of stout roots and stipes; stipes commonly 10 cm long and 2 mm thick, sometimes up to 20 cm long and 3 mm thick, terete, dark brown,

densely beset with horizontal bristles commonly 5 mm, rarely 8 mm long, rough in age as these are lost; frond up to 45 cm long and 18 cm wide, acuminate, the base rarely truncate, usually abruptly narrowed, with one or a few pairs of moderately reduced basal pinnæ, quadripinnatifid when well developed, with numerous pinnæ and pinnules usually imbricate; rachises of frond and pinnæ wingless toward the base; axes of pinnules and their divisions equally winged to a total width of commonly 0.5 mm; secondary pinnules commonly 5 on a side, the basal ones forked or with 3 or 4 segments; ultimate segments 4 to 6 mm long, obtuse; cell walls uniformly thin, and nearly straight; sori on shortened acroscopic basal secondary pinnules or segments, small, involucre turbinate with acute base and truncate apex, 0.6 to 1.2 mm long, 0.6 to 1.0 mm wide, with a wing narrowed at the base and disappearing at the apex.

The showiest Philippine *Trichomanes* and the most-collected species of the tree-fern and mossy-forest regions—there have been some sixty numbered distributions. It is moderately variable locally, as with long- or short-acuminate pinnæ with one or two or three pairs of reduced basal pinnæ, in the width of the segments, etc. Very large fronds usually produce larger sori than small fronds. There are also recognizable geographical races; thus the typical plants of central Luzon have sori 0.6 to 0.8 mm long and wide, while those of northern Luzon and of northern Mindanao have sori more than 1 mm long. The fertile segment is usually slightly constricted below the sorus; specimens from Mount Halcon, Mindoro, *Merrill 6073*, are so narrowed there that the sorus is practically stalked.

The range of variation in the Philippines blankets that in the Malay region, and east as far as Fiji, except as the cells of the lamina are commonly rather larger and the pinnæ are broader in the eastern part of the range. It is apparently rare in Borneo and in Sumatra, but commoner in Java. The few Papuan collections are identical with Philippine, and the same is essentially the case with those of the New Hebrides and Fiji. In Samoa, it is more variable, the involucres ranging from 0.7 to 1.2 mm in length, but it is still easily the same species. In Rarotonga there is some tendency toward a development of a web in the axils of the pinnules, producing a lamina broader than that of the segments; the pinnules are longer and the pinnæ therefore wider than is typical; and the wing of the in-

volucre is decidedly variable. Still I am disposed to treat it as the same species.

Elsewhere in Polynesia the local strains are divergent enough so that it seems best to conserve the measurable uniformity of the wide-spread species by treating the local forms as distinct.

77. TRICHOMANES BAUERIANUM Endlicher. Plate 42, fig. 2.

Trichomanes bauerianum ENDLICHER, Prod. Fl. Norfolk (1833) 17.

Fronde elastica ovato-lanceolata pinnata, pinnis bipinnatifidis, laciniis lineari-lanceolatis acutis, rhachi tereti hirta, involucris turbinatis alatis, ore integro.

Creseit in insula Norfolk. (Ferd. Bauer)

Species habitu Hymenophyllum scabrum *A. Rich. Fl. Nov. Zeel. t.* 14. *f.* 1. referens, Trichomani angustato Carmich. (*Hook et Grev. ic. t* 166.) proxime affinis, notis allatis facile distinguenda. Radix dense caespitosa, fibrosa, fibris rigidis flexuosis intortis. Stipites ex eadem radice plures erecti, stricti, teretiusculi, 3–4 pollicares, juniores pilis rufis tenuissimis fere 3 lineas longis obsiti, adultiores basi tantum pilosi, apicem versus nudi, subtilissime muricato-tuberculati. Frondes ovato-lanceolatae, 8–10 pollices longae, 5–6 pollices latae, elasticae, rhachi communi partialibusque hirtis, caeterum glabrae, pinnatae. Pinnae elongato-lanceolatae 3–4 pollicares, approximatim alternae, pinnatifidae, laciniis oppositis lanceolatis acutis. Sori in laciniis costae contiguis abbreviatis terminales. Involucrum turbinatum, basi attenuatum, utroque margine e fronde continua late alatum, ore truncato. Receptaculum exsertum, basi capsuliferum.—Endlicher, loc. cit.

I have seen no original specimen of this species, and would not distinguish it confidently by the diagnosis; but specimens in the United States National Herbarium, herbarium at Singapore, herbarium of the Bureau of Science, herbarium of the University of California, and my own herbarium, collected by Cunningham, by Robinson, and without data, seem all to represent a local form, conveniently distinguishable from the wide-spread *T. apiifolium*. It has the broad pinnæ and large cells of *T. apiifolium* in its atypical Polynesian form. It is usually less finely dissected, the segments being about 1 mm wide, but this is not constant. The sori, also, are commonly broader and mostly a millimeter or more in length. The most fixed peculiarity is that the involucre is immersed in the end of a short segment, and therefore broadly winged. Its mouth is either perfectly truncate or notched at the sides, thus varying in the direction of *T. polyanthum*.

Specimens from Lord Howe Island, distributed from the Botanic Gardens, Sydney, are intermediate between *T. bauerianum*

and *T. polyanthum*, and inconstant in character even on single fronds; some involucres are even narrowly winged, as in *T. apiifolium;* many are broadly winged on the basiscopic side and narrowly on the acroscopic; and many are immersed, as in *T. bauerianum*. The mouth is notched, or very shallowly bilabiate, never as distinctly as in *T. polyanthum*. The sorus is large for the group, 1.2 to 1.8 mm long. This material might be regarded as a local species; but I prefer to keep the number of such entities down, by construing it as a local variant of *T. bauerianum*. The Tahiti plant mentioned under *T. polyanthum* has gone still a step farther along the line leading to that species, as represented in Huahine and Raiatea.

78. TRICHOMANES POLYANTHUM Hooker. Plate 42, fig. 3.

Trichomanes polyanthum (errore *polyanthos*) HOOKER, Ic. (1848) No. 703.

Hymenophyllum polyanthum HOOKER, in Nightingale, Oceanic Sketches (1835) 132.

Hymenophyllum *polyanthum, n. sp.;* alatum, rigidum, fronde lanceolata pinnata, pinnis profunde bipinnatifidis, laciniis attenuatis integerrimis obtusis, involucris copiosis axillaribus lato-urceolatis nitidis, ore valde membranaceo dilatato obtuse bilabiato, stipite rachique (superne alata excepta) setosis.—Hooker, in Nightingale. [Locality not stated, but probably Huahine.]

Caudex short, erect, beset with reddish brown bristles about 4 mm long; stipes tufted, up to 10 cm long, remarkably stout, bristly, like the rachis, or rough after the bristles fall; frond up to 55 cm long and 16 cm wide, narrowed to both ends, quadripinnatifid, with linear segments hardly 1 mm wide, the minor axes narrowly winged; involucre 2 mm long, 1.6 mm wide, with two broad, short lips. Recently collected in Huahine (*Grant 5325*) and Raiatea (*Moore*). Reported also from Tahiti, from which island our specimens (*Vesco; Grant 3915*) have a smaller involucre, of the same shape.

This species was reduced by Hooker and Baker, Synopsis 86, to a variety of *T. apiifolium*, and by Christensen, Index, accordingly, to a variety of *T. bauerianum*. It is sufficiently distinguished from both by the form and size of the involucre, and the long series of gradually reduced basal pinnæ, the lowest only 1 to 2 cm long.

79. TRICHOMANES BALDWINII (Eaton) comb. nov. Plate 42, figs. 4 to 8.

Hymenophyllum Baldwinii EATON, Bull. Torr. Bot. Club 6 (1879) 293.

T. meifolium HILLEBRAND, Flora 637, non Bory.

Subspithamaeum: frondibus lanceolatis vel ovato-lanceolatis laete viridibus tenerrimis bi-tripinnatifidis; pinnis primariis oblique-divergentibus plerumque rachi anguste alatae adnatis inferioribus solutis; pinnulis simplicibus vel in segmentis paucis oblongis obtusis emarginatisve margine integerrimis nudis divisis; segmentis infimis cujusdam pinnulae abbreviatis apice soriferis; involucris subrotundis fere ad basin usque brevem alatam bilobis, lobis integerrimis, receptaculo columnari; stipite brevi rachique basin versus pilis rufis subulatis hispidis.

Abundant in a little valley in Oahu, at 2,500 feet above the sea; Hon. D. D. Baldwin, 1878.—Eaton, loc. cit.

Caudice erecto vel adscendente, apice setis castaneis immerso; stipitibus fasciculatis, plerumque ca. 10 cm altis, rhachibusque setis castaneis usque ad 4 mm longis horizontalibus vestitis in vetustate asperulis; fronde 15 ad 25 cm longa, late ovata, tri-quadripinnatifida; pinnis subsessilibus, imbricatis, lanceolato-ovatis, rhachibus anguste alatis; segmentis typice 0.7 mm latis, 2 ad 3 mm longis, herbaceis; cellularum parietibus rectiusculis tenuibus; soris in apices segmentorum lateralium brevium immersis, involucro obconico, plerumque 1 mm longo v. longiore, truncato vel saepius subbilabiato.

HAWAII, *Heller 2179*, in *Herb. Univ. Calif. 150243*, "collected on the island of Oahu, on the lower slopes of Konahuanui, above Manoa, on the ground." Other collections are *Heller 2741, 2816; Mann and Brigham 275; Faurie 101; Safford 886; Hitchcock 14797;* and distributions without collector's number by Brackenridge, Hillebrand, in great variety by Baldwin, and by others. On all the larger islands of the group.

This is a typical Hawaiian fern, varying widely, as do so many of the local species. There are two principal forms; one, compact, with comparatively broad segments and conspicuously setose axis; the other, comparatively finely dissected and naked, usually larger, and often with smaller sori and narrowly winged involucres. Hillebrand reports one specimen in which "the segments consist of the vein only, with a border of tissue in the axils." The involucre is never as strongly bilabiate as in typical *T. polyanthum*, nor so large; but it does vary from perfectly truncate to distinctly notched on the sides, and the variation in the wing covers the range from typical *T. apiifolium* to typical *T. bauerianum*. The pinnæ are in general broader than in any relative, but are approached in this respect by the other species in Polynesia. The best ready distinguishing character is the form of the frond. This is naturally not perfectly constant, but I find less than one frond in twenty of *T. Baldwinii* which is

more than twice as long as broad, and less than one in fifty (uninjured) of the other species in the group of which this is not so.

Hymenophyllum Baldwinii was described from small specimens with unusually cleft involucres. For recognition of its identity with the better-developed specimens, *T. meifolium* of Hillebrand and other students of Hawaiian ferns, I am indebted to Dr. H. L. Lyon. I had taken the latter for a new species; and print my diagnosis, prepared under this misapprehension, because it describes the species in its normal development better than does Eaton's. The small form, as far as known, is very local, in the mountains back of Honolulu.

12. THE GROUP OF TRICHOMANES RIGIDUM

Stipes clustered, commonly shorter than the fronds, wingless, axes deciduously hairy, with dark hairs under 2 mm long; fronds mostly ovate with broad bases, firm or harsh in texture, commonly so dissected as to leave the pinnules with an undivided laminar body much broader than the segments, the veins closely parallel in this lamina, and diverging into the segments; laminar cells with thick, pitted walls; involucres cylindrical.

Very common terrestrial ferns of some size, in all warm lands. *Trichomanes rigidum*, which typifies the group, was described from Jamaica. Some of the local species, as *T. longicollum*, have salient characteristics; but the common and wide-spread species are so alike that Hooker was unusually justified in combining them. Müller and van den Bosch thought they found tangible and constant microscopic peculiarities; but, after examining very many specimens of most of the species in great detail, I am satisfied that no other sharp line can be found separating *T. rigidum*, *T. mandioccanum*, *T. cupressoides*, *T. obscurum*, *T. dentatum*, and *T. elongatum*, save those that can be drawn on a map.

Although more distinct than several groups which have been given generic names, this one seems to have no distinctive name of any rank. *Trichomanes rigidum* was included in Presl's group or subgenus *Pachychaetum*, but that must be typified by *T. luschnatianum*, of the group of *T. radicans*.

Key to the species.

Sori long-stipitate.
- Pinnæ and pinnules imbricate..... 83. *T. longicollum.*
- Pinnæ and pinnules not imbricate..... 84. *T. extravagans.*

Sori subsessile, sessile, or subimmersed.
Rachis narrowly winged throughout.
Fronds more than 12 cm long.
Frond narrowed at base ..... 88. *T. stylosum.*
Frond broadest at base..... 89. *T. batrachoglossum.*
Fronds less than 8 cm long..... 85. *T. tereticaulum.*
Rachis winged toward apex only.
Rachis and stipe sulcate..... 86. *T. cupressoides.*
Axes terete or nearly so.
Walls wavy, only moderately thick..... 87. *T. mandioccanum.*
Walls very thick, not wavy.
Tips and segments normally flat.
Uncut lamina of pinnules oblanceolate.
82. *T. elongatum.*
Uncut lamina linear to elliptical..... 81. *T. dentatum.*
Tips and segments commonly curled..... 80. *T. obscurum.*

80. TRICHOMANES OBSCURUM Blume. Plates 43 and 44.

T. obscurum BLUME, Enum. (1828) 227; VAN DEN BOSCH, Hymen. Javan. 23, pl. 17.
Didymoglossum longisetum PRESL, Hymen. (1843) 23 (nomen), 49.
T. papillatum K. MÜLLER, Bot. Zeit. 12 (1854) 751.
T. saxatile MOORE, Gard. Chron. (1862) 45.
T. racemulosum VAN DEN BOSCH, Ned. Kruid. Arch. 5 [2] (1863) 210.
T. siamense CHRIST, Bot. Tidsk. 24 (1901) 103.
T. latipinnum COPELAND, Philip. Journ. Sci. 6 (1911) Bot. 71.
T. englerianum BRAUSE, Bot. Jahrb. 56 (1920) 37.

T. fronde bipinnata ovato-oblonga glabra, pinnis suboppositis lanceolatis, pinnulis sessilibus cuneato-oblongis profunde pinnatifidis, laciniis linearibus apice inciso-dentatis, rachi stipiteque teretibus subpubescentibus.

OBS. *Trichomanes bifidum*, Vent., cui simillimum, differt laciniis omnibus bifidis indusiorumque receptaculis multo brevioribus; *Trichomanes tamarisciforme*, Jacq. autem laciniis obtusis et forsan integerrimis; affine etiam *Tr. rigido*, Sw., sed laciniis haud lanceolatis distinctum.

Crescit in sylvis montanis humidioribus Javae et Moluccarum.

Var. B. *Obtusiusculum*, pinnulis trapezoideo-oblongis obtusis, laciniis cuneatis apice dentatis.

Crescit in Javae montosis Salak.

Var. C. *Adnatum*, pinnulis adnatis subbipinnatifidis, laciniis linearibus apice dentatis.

Crescit ad ripas fluviorum in syvis Javae occidentalis.—Blume, loc. cit.

This species has received careful analytical study by Karl Müller, Bot. Zeitung 12 (1854) 745–751, and van den Bosch, Hymen. Javan. (1861) 25, pl. 17. Müller contrasted it with "*T. rigidum* Hooker" as to the plant of Mauritius and Bourbon, which he distinguished as *T. achilleaefolium* Bory ex Willd. Van den Bosch's first observation as to *T. obscurum* is "species statura et divisione frondis insigniter ludens. Tales lusus sis-

tunt varietates *obtusiusculum* et *adnatum* BL." Except as some of the minute species (*bipunctatum* and *humile*) may exceed it in number of individuals, this is the commonest terrestrial *Trichomanes* throughout the Malay region, and varies as might be expected of so common a fern.

The stipes are commonly so densely fascicled that no caudex is visible; or its oldest remnant may project at the base or side of a mass of stipe bases, where it has outlasted these bases. Frequently, too, such a mass of stipe bases is just open enough to reveal glimpses of a rhizome, which is 2 to 3, rarely 4 mm in diameter, usually contorted, and clothed at the apex with black bristles 1 to 2 mm long. Commonly near the upper end of the Malay Peninsula, more rarely elsewhere (Java, *Raciborski;* Mindanao, *Copeland 1109*), the stipes are remote enough to leave the rhizome really evident. The stipes are terete, stout, commonly 8 cm tall, rarely up to 22 cm (Amboina, *Tornasi 1160;* this collection is also remarkable for a frond with radicant tip). The stipe and the terete part of the rachis are setose with short, deciduous, reddish-black bristles. Toward the apex the stipe is usually winged. On large specimens the rachises of the pinnæ are terete near the base; they are winged toward the apex, and throughout on small specimens.

The frond is commonly a half longer than the stipe; rarely shorter than the stipe; not commonly more than twice as long. A common size of well-developed fronds is 12 cm long by 10 cm wide. Small specimens and juvenile specimens have relatively narrow fronds. The smallest fruiting fronds observed are *Clemens 1213* from Mindanao, 3 cm long by 2 cm wide, on a stipe 2 cm long; and *Robinson 6348*, from Camarines, Luzon, 5 cm long by 2 cm wide, on a stipe 2 cm long. These small specimens usually have small sori, and the fronds are, of course, simple in some proportion to their size. Without seeing authentic specimens, I suppose that *T. saxatile* Moore and *T. racemulosum* van den Bosch, both described from Borneo, are dwarf specimens of *T. obscurum*. Neither can be distinguished by description from such small specimens as I have seen, and both belong certainly in this group. *Trichomanes Warburgii* Christ, Monsunia 1 (1900) 55, may be like these or may be a small form or relative of *T. grande*.

Trichomanes siamense Christ, Bot. Tidsk. 24 (1901) 103, described as differing from *T. rigidum* in having a lanceolate-ovate frond, with short pinnules and pinnæ, is probably another of these small forms of *T. obscurum*. Its blackish color and co-

riaceous texture indicate that it belongs here rather than with "*T. millefolium* Presl."

Trichomanes englerianum Brause, Bot. Jahrb. 56 (1920) 37, is another name for these small, relatively narrow forms of *T. obscurum*, this time from New Guinea. The sori are larger than typical; otherwise, there is no item in its long description to make one suspect that it is different from *T. racemulosum* or *T. siamense*. Microscopic examination of the type collection, *Ledermann 11026a*, shows complete structural identity with *T. obscurum*.

The frond is normally bipinnate, with lacerate pinnules. In the form and the dissection of the pinnules, the greatest diversity occurs. Most commonly, they are deeply incised at the base, and dentate at the apex, with all teeth and segments acute. As the pinnule narrows from base to apex, its undissected middle strip is more or less of one width throughout (as also in *T. dentatum*).

Trichomanes papillatum K. Müller is a form occasional in the Philippines, with narrow, falcate pinnules, toothed but not incised. It intergrades with the typical plant, and is not a geographical form or strain. It was based on a Cuming collection, without citation of number; "*T. rigidum* Hook. . . . planta Cumingiana" must refer to Species Filicum I: 134, where the citation is "*Cuming n. 134 and 189.*" Müller, in his preliminary comparison with *T. obscurum*, wrote, "Eine von Cuming auf den Philippinen (?) gesammelte Art (weicht) sofort durch einen sehr zarten und schmalen, zweifach gefiederten Wedel ab, dessen einzelne Fiedern wiederum ausserordentlich schmal sind." This fits *189* and not *134* in the United States National Herbarium, Gray Herbarium, and herbarium at Singapore. The Bureau of Science herbarium, and my own, have both forms in *134;* and *189* also is mixed in the Bureau of Science herbarium. But *189*, however peculiar in appearance, is only an ill-developed representative of perhaps the commonest species in the Philippines. There is no line at all between it and the most ample forms of *T. obscurum;* and it is common for this form and more amply developed plants to appear in the same collection.

The form of the laminar cells is as variable as that of the pinnules, and to some extent correlated therewith. The veins fork at a very acute angle, the branches running at first closely parallel. Between these veins the laminar cells tend to be elongate and quadrilateral. If the pinnules are not much dissected, so that there is a relatively considerable intact area with many

parallel veins, this form of cell predominates and gives character to the frond. Toward (not in) the margins, and in the axils of the segments, the cells tend to be isodiametric and irregular or hexagonal; and in more dissected fronds, and especially in those of lax venation, this general type of cell predominates and seems to be characteristic. The structure of the wall is reasonably uniform. All walls are very thick. As a whole they are straight or curved, but not wavy; this may be seen by viewing them with low magnification, or with high magnification a little out of focus. The volume of these walls is about half occupied by pits, each extending less than halfway through the (lateral) wall, and more or less as broad as deep. The solid median part of the wall may be straight, with the wall between adjacent pits appearing, in exact focus, as projecting teeth, rods, or spines; or it may be moderately deflected if the pits are very deep and their bottoms tend to be crowded between the bottoms of the pits of the adjacent cell. But this solid median part of the wall of typical plants does not become regularly wavy or zigzag, "fulmeni formiflexuosis seu crenatis," as Müller expressed it; as it does in some related American and African species, and in *T. setaceum.*

The sori are commonly borne on the lowest acropetal segments of the pinnules. If the fruiting is luxuriant, a pinnule may bear several sori. The involucre is cylindrical with an acute base, the apex truncate, or slightly notched. It is usually very narrowly winged to the top, the wing being broader at the base. The lamina of the segment is sometimes narrowed below the sorus, but the sorus is never really stalked. The receptacle is far-exserted, two to four or more times the length of the involucre, and is usually curved.

Trichomanes obscurum has its center of distribution in the Malay region, and ranges to Ceylon, India, Formosa, and Papua.

Trichomanes latipinnum Copeland, described from Papua, is a form with remarkably broad pinnæ and pinnules, the latter deeply dissected, and persistently hairy axes. Its sori are mostly more broadly winged than in common *T. obscurum,* but this is inconstant. As a single collection, it looked quite distinct, but I believe now that it intergrades with the typical form. *Burkill and Holttum 8465,* from Pahang, is very similar in form and dissection.

Variable in every land from which we have collections enough to be likely to illustrate its variability, *T. obscurum* is distinctly richer in forms in the Malay Peninsula than in the

Philippines, Borneo, or Java. It has just been noted that a form with wide pinnæ is found here. There are two notable forms with pinnæ atypically dissected. One of these has been confused with *T. setaceum,* but has fewer elongate segments, and these are more restricted to the bases of the pinnules. If of the normal size of *T. obscurum,* these have its typical structure. Although commonest on the Peninsula, such plants are occasionally collected throughout the Malay region and in the Philippines; Philippine examples are *Bolster 219,* from Mindanao; *Bur. For. 19067 Curran,* from Negros; and *Bur. Sci. 7561 Ramos,* from Cagayan, Luzon. They intergrade with the type of *T. obscurum,* but I have not found that they do so with *T. setaceum.* The deviation, however, is in the direction of that species, and of the *Pluma* group.

The majority of the Peninsular specimens with this type of dissection are small plants. Correlated herewith, whether they be regarded as young plants, as aberrant individuals, or as representatives of a distinct strain or even species, is the fact that they are more herbaceous than is typical *T. obscurum.* A further correlation is probably presented by the structure of the lateral walls, which tend to be wavy or zigzag, another deviation in the direction of *T. setaceum.* Examples, citing Singapore field numbers, are *16027, 16200,* and *20775,* from Pahang; *9611,* and two unnumbered collections by Ridley, from Perak. No. *9611* bears an unpublished specific name. These may be *T. siamense.*

The other form bears ample fronds, notable for the number of fairly uniform segments. Singapore Nos. *11043* and *15709,* from Pahang, and *7871,* from Selangor, are, as specimens of *T. obscurum,* remarkably thin and dissected. Finally, a Johore specimen collected by Holttum, without number, is exceptionally thin, and has the cell structure of *T. cupressoides,* to which species, if it came from Mauritius or Africa, I would not hesitate to refer it.

81. **TRICHOMANES DENTATUM** van den Bosch. Plates 45 and 46.

Trichomanes dentatum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 182; Journ. Bot. Néerl. 1 (1861) 363.
T. cartilagineum VIEILLARD and PANCHER, ex van den Bosch, Ned. Kruid. Arch. 5 (1861) 183 and 363.
T. platyderon FOURNIER, Bull. Soc. Bot. France 16 (1869) 392.
T. Seemannes CARRUTHERS in Flora Vitiensis (1873) 345.

T. dentatum. T. rigidum BRACK. (non al.) in WILK. expl. exped. XVI p. 260. Fronde ovata acuminata bipinnatifida, laciniis primariis infimis

horizontalibus, sequentibus sensim minus divergentibus, supremis erectis, contiguis subaequidistantibus lanceolatis vel oblongo-lanceolatis, secundariis patulis erectisve contiguis planis, infimis laciniarum inferiorum utrinque remote subpinnatifide incisis, reliquis indivisis, cunctis margine obtuse dentatis, rhachi anguste marginata olivaceo-fusca, venulis laxiusculis parum conspicuis, cellulis forma et magnitudine valde inaequalibus irregularibusque (parvis usque magnis, varie angulosis, marginalibus minimis semihexaëdris), cunctis regulariter fere hyalino-reticulatis, interaneis amorphis spissiusculis e viridi olivaceis in reticuli spatia quadrangula, oblonga, rotundata dispositis, soris in laciniis secundariis axillaribus, in dente obsoleto immersis, indusio utrinque anguste marginato cylindrico parumper ventricoso, sursum in limbum patentem undulatum tubo fere 2 latiorem subito dilatato, stipitibus e rhizomate brevi polyrrhizo approximatis flexuosis apice angustissime alatis 8–10 centim. longis. Frons 8–9 centim. longa, 5–6½ lata opaca firma obscure viridis.

Ex affinitate T. elongati. . . .

Hab. Nova Caledonia (Isle of Pines) CUMING No. 7 (H. Bertol.); Ins. Societatis (Taïti), WILKES.—Van den Bosch, Ned. Kruid. Arch. 5 (1861) 182.

It will be noted that van den Bosch began with the citation of a Brackenridge fern from Tahiti, and concluded by citing a New Caledonia fern before the Tahitian. In the case of *T. cartilagineum,* he began by a nominal citation of Brackenridge, and concluded by citing Society Islands and then Fiji specimens. I believe that both are properly typified by Tahiti specimens. I regard all of them as one species; but the question of type locality is not without eventual importance, as van den Bosch may not be the last student to pay specific respect to minute differences.

As I construe it, *T. dentatum* holds the same place in Polynesia that *T. obscurum* does in Malaya, the common terrestrial species of cool, wet banks. The two species are not at all sharply distinguished, and their combination would be quite defensible. However, the typical *T. dentatum* of Tahiti is constantly distinguishable from *T. obscurum* of Java, and it will conform to usage without adding to the inevitable difficulty in drawing a line between them if the forms from New Caledonia eastward are construed as *T. dentatum* and those from Papua westward as *T. obscurum.* On the whole—that is, treating collectively the mass of material of both under observation—*T. dentatum* has less-dissected pinnules than *T. obscurum;* undivided segments or teeth with single veins are less numerous on the frond and less uniformly present on the specimens; the tendency of the tips to be curled and rolled backward is decidedly less developed, so that the herbarium specimens lie flatter; the sori are more nearly

stalked and still more conspicuously deflected from the plane of the frond; and the involucres are rather more slender, and more evidently bilabiate.

Trichomanes Seemannii Carruthers is typified by *Seemann 782*. As represented in the Gray Herbarium, this seems to me to be an unusually thin specimen of *T. dentatum*. Being thin as a whole, it has walls less than usually solid, the middle strip of lateral walls being more zigzag than usual, and the pitting of the superficial cells, in surface view, evident only near the sides of the cells. I do not believe that such distinctive character as it has is fixed.

Trichomanes ferrugineum Fournier, Bull. Soc. Bot. France 16 (1869) 392, is supposed to be distinguished by a shorter and wider involucre. The specimens I have seen so named are *T. dentatum*.

Our specimens are from New Caledonia, Vanikoro, Tanna, Fiji, Samoa, Rarotonga, and the Society Islands.

Judging by description only, *T. pumilum* van den Bosch, Ann. Sci. Nat. IV 15 (1861) 89, should be a small relative or form of *T. dentatum*.

82. **TRICHOMANES ELONGATUM** A. Cunningham. Plate 47, figs. 1 and 2.

Trichomanes elongatum A. CUNNINGHAM, Comp. to Bot. Mag. 2 (1836) 368; HOOKER, Ic. Pl. pl. 701.

Fronde deltoideo-ovata acuta bipinnata, pinnis alternis lanceolatis, pinnulis basi profunde dissectis apice dilatatis inciso-lobatis lobis denticulatis, rachi stipiteque teretibus nudis, involucro oblongo compressiusculo subalato, ore bilabiato, labiis crenulatis, receptaculo elongato involucro multoties longiore.

New Zealand (Northern Island). Dark ravines in the forests of Wangaroa, etc.—1834, *A. Cunningham*.

Obs. Upon this beautiful and hitherto undescribed species, a small *Jungermannia* is occasional parasitical.—Hooker, loc. cit.

This species is very near to *T. dentatum*. They are alike, and distinct from *T. obscurum* in that the fronds are usually plane in the herbarium, or with at most moderately reflexed tips of specimens dry enough before pressing to cause other thin ferns to wilt. In New Zealand specimens the deep dissection of the base of the pinnule, and the shallow dissection toward its apex are fairly constant and diagnostic. The effect is that the undissected axis of an ovate-lanceolate pinnule is oblanceolate in *T. elongatum* and linear-elliptic in *T. dentatum*. The apices of the pinnules are also more rounded in *T. elongatum*, more acute in *T. dentatum*. The species is common

and uniform in the North Island of New Zealand. I refer to it also a larger fern from Eua (*Parks 16232*). Specimens from New South Wales and Queensland, distributed as *T. rigidum*, are neither typical nor uniform, being between *T. elongatum* and *T. dentatum;* I refer them to the former. *T. elongatum* has also been reported from New Caledonia, Fiji, and Samoa; but all so-labelled specimens I have seen from any of these (except some not in this group of species) are *T. dentatum.*

Trichomanes polyodon Colenso has been reduced to *T. elongatum* by Cheeseman.

83. TRICHOMANES LONGICOLLUM van den Bosch. Plate 47, figs. 3 to 5.

Trichomanes longicollum VAN DEN BOSCH, Ann. Sci. Nat. IV 15 (1861) 90.

Fronde subtriangulari-ovata acuminata superne pinnatifida, inferne pinnata (pinnis 2–3-pinnatifidis), laciniis superioribus erecto-patulis contiguis, inferioribus patulo-divergentibus invicem tegentibus, laciniis valde abbreviatis dentiformibus, cellulis teneris parvis mediocribusque irregularibus amoene viridibus acute crenulatis regulariter poroso-punctatis, soris in laciniis secundariis axillaribus longissime exsertis recurvis anguste cylindricis longe deorsum angustatis. Rhizoma breve adscendens radiculosum nigro-fusco-hirsutum stipites emittens fasciculatos (8 centim. longos) validos olivaceos teretiusculos; frons 15 centim. longa, basi 9, medio 6,5 lata rigidiuscula e flavo-viridi olivacea.

Hab. In sylvis montium, Balade [New Caledonia], VIEILLARD, herb. n. 1662.—Van den Bosch, loc. cit.

The fronds are exceptionally thin and herbaceous for this group. Both pinnæ and pinnules are congested and, therefore, without being wide, are conspicuously imbricate. The pinnules are not deeply dissected unless at the base. It thus resembles *T. elongatum,* from which it is clearly distinguished solely by the stalked sori. An examination of several collections shows uniformly a double pitting or areolation of the walls, but a similar structure is occasionally found in *T. dentatum* and *T. obscurum.*

Trichomanes longicollum seems not to be common in New Caledonia, and is unknown elsewhere.

84. TRICHOMANES EXTRAVAGANS Copeland sp. nov. Plate 48.

T. gregis T. rigidi soris exaltatis insigne, stipitibus dense caespitosis, 6 ad 10 cm altis, teretibus setulis deciduis aspersis; fronde usque ad 10 cm alta et 8 cm lata, deltoideo-ovata, subcoriacea, atroviride, tripinnatifida, rhachi deorsum tereta, apicem

versus alata; pinnis imbricatis, infimis oppositis 4 cm longis, 2.5 cm latis, rhachi basi tereta setosa, alibi alata, pinnulis paucis, oblongis, ad alam latam pinnatifidis, segmentis paucis angustis, ad basin acroscopicam soriferis; pinnis superioribus pinnatifidis segmentis basi dilatatis acroscopice soriferis; ramo sorifero segmenti attenuata, deinde filiforme, ca. 3 mm longo, recto vel reflexo; involucro 1 mm longo, subventricoso vel elongato cyathiforme obsolete alato, ore truncato, receptaculo duplo longiore sed fragile.

LUZON, Tayabas Province, Mount Binuang, *Bur. Sci. 28465 Ramos and Edaño.*

A species of bizarre appearance because of the numerous long-stalked sori; remarkable also for the few pinnules and segments and the dilation of their bases.

33. TRICHOMANES TERETICAULUM Ching.

T. tereticaulum CHING, Sinensia 1 (1929) 2; HU and CHING, Ic. Fil. Sinic. 5, pl. 3.

Eutrichomanes, subsect. Ptilophyllum, v. A. v. R. in Handb. Malay. Ferns, p. 83 (1908). Rhizome naked or nearly so, very short, interwoven in dense wiry fibrous roots; stipes densely caespitose-fasciculate, wiry, rigid, teret, not winged or only narrowly winged towards the apex, 4–6 cm long or longer, naked. Fronds glabrous, subdeltoid to linear-oblong, 4–6 cm long, 2–2.5 cm broad, 3-pinnatifid, rachis narrowly winged throughout; pinnae 3–5 on each side, remote erect, patent, oblong-ovate, 1–2 cm. long, the upper ones gradually shortened; pinnules 2–4, entire or 2–3 pinnatifid into small linear, entire, rounded segments; texture thin-herbaceous, translucent, dull-green; veins distinct, 1 to each segment, spurious veinlets wanting. Sori terminal on ultimate segments, mostly immersed, 2–3 to each pinna, indusium short funnel-shaped slightly dilated, obscurely undulate at mouth, not bifid, receptacle long-exserted, stout, dark-brown. . . .

Hab. Seh-feng Dar Shan, S. Kwangsi, near the border of Tonkin. . . . about 1800 ft. elevation. (*R. C. Ching*, No. 8239.)—Ching, loc. cit.

A stunted representative of *T. obscurum*, not widely separated from the small plants already known from the northern part of the range of that species. The specimen in the herbarium of the University of California conforms perfectly to the description, including stipes 6 cm long, but no frond quite reaching that length; but the longest fronds present have much shorter stipes, and the long stipes bear only the old bases of fronds presumably larger. I suspect, therefore, that in full development it may be indistinguishable from the small Peninsular plants already discussed; and that, if it be specifically distinct

from *T. obscurum* it is *T. siamense.* It has the zigzag, toothed lateral walls of the small Peninsular specimens.

The reference to *Ptilophyllum* v. A. v. R. is correct, but that "subsection" might fitly occupy by itself a chamber of horrors in the museum of taxonomic botany. It included *T. pallidum, T. humile, T. bipunctatum, T. auriculatum, T. pyxidiferum, T. maximum,* and *T. grande,* representing as many properly distinct groups; but it did not include any relative of *T. teretiscaulum,* nor did it have one species in common with the *Ptilophyllum* of van den Bosch or Prantl, from one or both of whom the name must have been pirated. Van den Bosch first used it for a section name, in unwarranted substitution for *Achomanes* and *Pseudachomanes* of Presl. Prantl endowed it, as a genus, with species, deliberately including the older *Feea* but discarding the name "weil letzterer sich nur auf sehr wenige Arten bezog," and in spite of the fact that *Ptilophyllum* was preoccupied. Less intentionally, presumably, he included the type species of *Trichomanes* itself.

86. TRICHOMANES CUPRESSOIDES Desvaux. Plate 49.

T. cupressoides DESVAUX, Prod. de la Fam. des Foug. (1827) 330.
T. obscurum var. *pectinatum* METTENIUS, in Kuhn, Fil. Afric. 35.

Frondibus elongato-deltoideis, decurrentè tripinnatifidis; pinnellis adpressis, nervosis apici dentatis: infimis basi bicuspidato-subulatis, columellis plerisque inclusis; rachibus subpruinoso-pilosis: partialibus subnudis; stipite tereti.

Habitat in insulis Séchelles. Frondes caespitosae.—Desvaux, loc. cit.

As is true of many of the earlier descriptions, this might apply to any species in its group. I interpret the species by a specimen collected in Usambara, *Holst 4269, U. S. Nat. Herb. 807579,* determined by Hieronymus as *T. obscurum* Bl. var. *pectinata* Mett. This name was published without description, as a reduction to *T. obscurum* of *T. cupressoides;* it is a reasonable assumption that Mettenius and Hieronymus knew their plants.

The frond is deltoid-ovate, 15 cm long, on a stipe of the same length. The pinnules are oblong, obtuse, obliquely and symmetrically pinnatifid almost to the costa, with the larger segments narrowly toothed. The older, smaller fronds, produced when the plant was younger, are less dissected, falling within the range of *T. obscurum;* but they are more delicate in texture, and no frond of *T. obscurum* is as much or as regularly dissected as are the three well developed fronds of this specimen. Oc-

casional fronds of *T. obscurum*, sometimes mistaken for *T. setaceum*, bear even longer and narrower segments, but the dissection is not symmetrical, and leaves a larger intact medial lamina. The walls of *T. cupressoides* are thinner, and less largely composed of cellulose (in distinction to pits), wherefore the solid element of the lateral walls, as seen in exact focus, appears more wavy. The rachises are broadly sulcate, and the stipes of the larger fronds are deeply so. The tendency of the tips to curl is less evident than in *T. obscurum*. The receptacle projects by less than the length of the short involucre.

The species concept of Hooker and Mettenius would justify identification of this fern as *T. rigidum* and *T. obscurum*. That of to-day does not. The dissection and the sulcate axes seem easily diagnostic. Judging by this specimen (possibly because a single plant is in hand), it seems decidedly more distinct from *T. obscurum* than does *T. dentatum*.

87. TRICHOMANES MANDIOCCANUM Raddi.

Trichomanes mandioccanum RADDI Pl. Bras. 1 (1825) 64, t. 79, f. 2.

Without entire confidence, I accept this identification of *Warnoth 334, U. S. Nat. Herb. 554551*, from Amani, German East Africa. The identity with specimens from near Rio de Janeiro is approximate, the latter having more conspicuously wavy lateral walls of laminar cells, but those of this specimen being more wavy than those of any Oriental species of the group. The fact is neither overlooked nor explained that Müller, Bot. Zeitung 12 (1854) 750, described these walls as straight. The dissection of the frond is as fine as in *T. cupressoides*, but less regular. The segments are as badly curled as is common in *T. obscurum*, but in this case, the fronds being much thinner, it is probably due to the pressing of a wilted specimen. *Buchanan 522*, from Natal, is possibly the same species.

In view of uncertainty of identification, a full description of this Brazilian species may be omitted here.

88. TRICHOMANES STYLOSUM Poiret. Plate 51, figs. 3 to 5.

Trichomanes stylosum POIRET, in Lam. Enc. 8 (1808) 82.

Trichomanes frondibus subtripinnatis, pinnis alternis, pinnulis decurrentibus; laciniis linearibus, subintegris, obtusis; fructificationibus terminalibus, solitariis, longè stylatis.

Ses souches sont épaisses, noirâtres: il s'en élève des feuilles pétiolées, droites, presque trois fois ailées, longues de dix à quinze pouces, acuminées, d'un vert-sombre, point transparentes, très-glabres, composées de folioles

alternes, lancéolées; de pinnules alternes, légèrement décurrentes, presque pinnatifides ou divisées en découpures presque simples, entières, courtes, linéaires, obtuses à leur sommet, quelquefois un peu échancrées; leur fructification située au sommet des découpures inférieures, sous la forme d'un petit godet en entonnoir, d'un brun-foncé, traversé par une columelle en forme de style capillaire, très-saillant en dehors, long de deux à trois lignes, caduc. Les pétioles sont d'un brun-foncé, presque cylindriques, glabres, souples & durs.

Cette espèce a été recueillie à l'île de Madagascar par M. du Petit-Thouars.—Poiret, loc. cit.

I have no authentic material of any Madagascar species of this group. In the United States National Herbarium are sheets *51118* and *51119*, collected by Dr. P. B. Ayres in 1862, determined at Kew as *T. rigidum; 593169*, collected by Mrs. N. Pike in 1869, undetermined; *817018 C. E. Bewsher* in 1888, from Kew; and *817019*, from Berlin, without data except "Mauritius," the last two as *T. rigidum*. All are one species, and it is the species described by Müller, Bot. Zeit. 12 (1864) 750, as *T. achilleaefolium* Willd. I assume that he was correct, and that van den Bosch, Synopsis 32, and Christensen have correctly construed this as *T. stylosum* Poir. It is obviously impossible to distinguish the components of Hooker's *T. rigidum* by diagnoses of the time of Poiret, Bory, Willdenow, and Desvaux.

This species has more slender and less coriaceous fronds than *T. obscurum*. An ordinary frond is 20 by 6 cm; the largest seen, 25 by 10 cm. They are somewhat narrowed at the base; stipe and rachis are comparatively naked; the rachis of most fronds is narrowly winged quite to the base; and the structure of the walls of the laminar cells is diagnostically different, the pits being much smaller and occupying a very minor part of the entire space of the walls.

89. **TRICHOMANES BATRACHOGLOSSUM** Copeland sp. nov. Plate 50; Plate 51, figs. 1 and 2.

T. gregis T. rigidi, stipitibus fasciculatis, 15 cm altis, basi setis obscuris 1 ad 1.5 mm longis praeditis, sursum glabratis leviter sulcatis; fronde 15 cm alta anguste deltoidea, rhachi anguste alata, late sulcata, superne costisque pinnarum setosis, pinnis haud imbricatis inferioribus oppositis; pinnis infimis usque ad 5 cm longis, 2 cm latis, basiscopice auctis, bipinnatifidis, costis distinctius alatis; pinnis sequentibus infimis 3 cm longis, 12 mm latis, obtusis, ad alam conspicuam costae pinnatifidis, segmentis majoribus 2 mm latis, angulo acuto incisis, lamina coriacea atroviride, parietibus lateralibus cellularum in foco

exacto tenuibus late undulatis, soris multis, parvis, sessilibus basi vix immersis, inflexis, involucro 1 mm longo, cylindrico, angustissime alato, ore truncato vel saepius minute dilatato, receptaculo duplo vel triplo longiore, curvato.

LIBERIA, *O. F. Cook 392*, type *U. S. Nat. Herb. 946305*.

A member of the group of *T. rigidum*, as shown by the fascicled stipes, pubescence, texture, and sori; very distinct within the group, because of the nonterete, winged axes, small (basal excepted) pinnæ, and sori bent above the plane of the frond. The structure of the walls suggests that of *T. mandioccanum*.

13. CEPHALOMANES; THE GROUP OF TRICHOMANES JAVANICUM

Terrestrial; rhizome ascending, in age becoming an erect caudex, supported by many stout, dark roots; fronds fasciculate, mostly lanceolate, simply pinnate (rarely only pinnatifid), dark, harsh in texture, with coarse veins and large laminar cells, the walls thin in proportion to the size of the cells, and the contents dark; involucres cylindrical (rarely shortened to obconic), very firm; receptacle commonly long-exserted, coarse, sometimes enlarged at the tip. An exceptionally large and globose receptacle-tip, as observed by Presl, was responsible for his generic name, *Cephalomanes*.

The caespitose, nondeltoid, harsh, dark, simply pinnate fronds make this an exceptionally easily recognized group of species. It ranges from Malaya to Madagascar, the Himalayas, and the Marquesas. *Trichomanes javanicum* occupies the middle area, and is replaced, as a very common fern, by *T. asplenioides* in the Philippines, and by *T. boryanum* in Polynesia. *Trichomanes atrovirens* ranges from Luzon to Papua, and may prove to be the common species in the latter. The other species are comparatively local.

A notable characteristic of this group is the tendency to produce fruit while still in a stage of growth well short of the full maturity in which the characteristics of the several species reach their full development. The great majority of the individuals which reach a fruiting stage evidently never attain a more perfect maturity. The semiadult plants, of whatever species, have short stipes, small fronds, sori aggregated near the apex, and in general shorter involucres, as compared with really mature individuals of the same species; and the several species, as represented by these semiadult plants, are far less distinct than when known by older and perfectly developed specimens.

Key to the species.

Fronds pinnate at base only, if at all..... 101. *T. crassum.*
Fronds pinnate.
Pinnæ broadly cordate..... 100. *T. madagascariense.*
Pinnæ not cordate.
Sori borne in a terminal spike or panicle.
Involucres truncate.
Rachis wingless, sori large..... 92. *T. sumatranum.*
Rachis narrowly winged..... 96. *T. Kingii.*
Mouth of involucre somewhat dilated..... 97. *T. acrosorum.*
Sori on normal pinnæ, mouth ciliate..... 99. *T. Foersteri.*
Sori on normal pinnæ, mouth not ciliate.
Sori on acroscopic margin of pinnæ, and salient beyond it.
Mouth of involucre truncate..... 90. *T. javanicum.*
Mouth slightly dilated, pinnæ very imbricate.
Stipe short, pinnæ lacerate..... 94. *T. atrovirens.*
Stipe long, pinnæ shallowly cut....95. *T. densinervium.*
Mouth conspicuously dilated..... 98. *T. boryanum.*
Sori in notches on acroscopic margin.... 91. *T. singaporianum.*
Sori tending to be apical on the pinnæ.
Sori large, restricted to apex of frond.
92. *T. sumatranum.*
Sori of mature plants not confined to apex.
93. *T. asplenioides.*

90. TRICHOMANES JAVANICUM Blume. Plate 52, fig. 1.

T. javanicum BLUME, Enumeratio (1828) 224.
Cephalomanes javanicum VAN DEN BOSCH, Hymen. Javan. 30, pl. 22.
Cephalomanes Zollingeri VAN DEN BOSCH, Hymen. Javan. 31, pl. 23.
Cephalomanes rhomboideum VAN DEN BOSCH, Hymen. Javan. 33, pl. 24, but not *Trichomanes rhomboideum* J. Smith.

T. fronde pinnata lanceolata acuminata glabra, pinnis subsessilibus cuneato-oblongis obtusis serratis vel inciso-serratis striatis pellucidis glabris, stipite rachique setosis.

OBS. Affine *Trichomani heterophyllo,* Humb.

Crescit in umbrosis humidis Javae interioris.

Var. B. Serraturis setaceis.

Crescit in sylvis insulae Nusae Kambang.—Blume, loc. cit.

This species properly typifies the group, although *T. atrovirens* is technically the type of Presl's genus *Cephalomanes.*

Trichomanes javanicum is a very common fern in Java, Sumatra, and the Peninsula, and varies as common ferns are wont to do. A few specimens might well seem to represent distinct species, especially if chosen to illustrate its range of forms; and it is worthy of note that the two van den Bosch species

which I do not maintain were both based on Zollinger specimens regarded as *T. javanicum* by the collector. *Trichomanes Zollingeri* is a half-grown plant, with the sori restricted to the reduced pinnæ near the apex. It is represented by a majority of the specimens, in herbaria and in the field. *Cephalomanes rhomboideum* is the form with most cut margin, particularly with prolonged, curved prongs from the basiscopic margin. It has not the very numerous, short, widely imbricate, dark brownish pinnæ of the Philippine plant, *T. atrovirens,* with which van den Bosch confused it.

Trichomanes javanicum, well developed, has fronds 20 to 25 cm long, on stipes 8 to 12 cm tall, the sori borne on the acroscopic margin of the pinnæ, in full fruit extending to, but not usually around, the apex. The indusium is commonly 2 mm long, tubular, somewhat immersed, or slightly winged at the base, or sessile, ribbed rather than winged at the sides, truncate at the apex, sometimes undulate or slightly notched at the sides. Over a wide area, it occupies the place taken in the Philippines by *T. asplenioides,* and in Polynesia by *T. boryanum.* It is distinguished from the latter by the truncate involucre; from the former, by the position of the sori, and less certainly by more numerous and narrower pinnæ. The other species of the group are comparatively local and rare.

Java to the Himalayas and Papua.

Several small Bornean specimens—*Clemens 9478* and *Ramos 1268* from Sandakan; *Bur. Sci. 932 native collector,* from Sarawak—have winged or marginate involucres with crenate, slightly dilate mouths. The crenation is less conspicuous on the largest such specimen, *Boden-Kloss 19170.* These may represent a distinct local species, but I leave them in *T. javanicum* until surer of its limits.

91. TRICHOMANES SINGAPORIANUM v. A. van Rosenburgh. Plate 52, fig. 5

T. singaporianum v. A. VAN ROSENBURGH, Bull. Jard. Buit. II 20 (1915) 25.

Cephalomanes singaporianum VAN DEN BOSCH, Synopsis (1859) 11.

T. javanicum HOOKER and GREVILLE, Ic. Fil. pl. 240, non Blume.

T. Christii ROSENST., Bull. Jard. Buit. II 2 (1911) 27, non Copel.

T. Rosenstockii v. A. VAN ROSENBURGH, Bull. Jard. Buit. II 7 (1912) 27.

T. borneense v. A. VAN ROSENBURGH, Bull. Jard. Buit. II 20 (1915) 25.

Fronde pinnata lato-lanceolata, pinnis subsessilibus oblongis basi oblique cuneatis obtusis inciso-subpinnatifidis (praecipue margine superiore)

nervosis glabris, stipite rachique marginatis setosis, involucris in sinubus laciniarum superiorum plerumque solitariis.

Hab. . . . In Insula Singapore. *N. Wallich, M.D.*—Hooker and Greville, loc. cit.

T. singaporianum . . . has the pinnae incised towards the base, especially on the upper side, less so on the lower side, with the lobules subtriangular, narrowed toward the apex, the sori in the sinuses of the lobules, the indusia immersed ca ½-way down, more or less conspicuously urceolate and narrowed at the mouth.—V. A. van Rosenburgh, loc. cit.

Neither van den Bosch nor van Alderwerelt knew this plant except through the eyes of Hooker and Greville; however, they named a plant, and therein had better luck than sometimes falls to those who base names on pictures. The Wallich specimen was immature, as shown by its size and imperfect dissection. Well grown fronds reach a length of 20 cm, although 15 cm is commoner. The pinnæ, except near their apices, are regularly lobate-pinnatifid halfway to the costa on the acroscopic side, the lobes usually narrowly or broadly oblong, and rounded or truncate. The involucres are sessile or slightly immersed, and only 1 mm long, falling far short of the general outline of the frond.

There are ten sheets in the Singapore Herbarium, from Singapore, Johore, Selangor, and Malacca; the plant is also in Borneo.

Van Alderwerelt's description of *T. borneense* is perfectly applicable to well-developed *T. singaporianum.*

92. TRICHOMANES SUMATRANUM v. A. van Rosenburgh. Plate 53, fig. 4.

53, fig. 4.

Trichomanes (*Cephalomanes*) *sumatranum* V. A. VAN ROSENBURGH, Bull. Dept. Agr. Ind. Néerl. No. 18 (1908) 4.

T. javanico et asplenioideo affine. Pinnae margine acroscopico lobatae, apice dentatae, lobis apice dentatis, inferioribus (1–3) ± elongatis et auriculiformibus, lobis inferioribus pinnarum inferiorum liberis et plerumque petiolatis; pinnae superiores apicem frondis versus sensim reductae, summae valde contractae, petioliformes, anguste marginatae. Sori apices pinnarum superiorum occupantes, in pinnis reductis solitarii, in pinnis caeteris 1 vel plures, indusio marginato, limbo erecto, truncato, leviter concavo, alis in dentes laterales minutos excurrentibus.

Sumatra (Burck).—V. A. van Rosenburgh, loc. cit.

As described, this species would have bipinnate fronds, but I am satisfied that such an appearance, when it occurs, is due to damage or dissolution. The pinnæ of well developed fronds are broad at the base, usually narrowing thence to the apex. The basiscopic margin is likely to bear a few short, sharp, appressed teeth, and the upper margin to have a few deep incisions; still the pinnæ are exceptionally entire, for this group. The sori are

grouped near the apex, even in the best-developed specimens seen, and the lamina is so contracted from their bases that they appear distinctly stalked. Their position is distal, as in *T. asplenioides,* in distinction to acropetal, as in *T. javanicum;* however, the affinity to the latter species is probably the closer. The involucre is large, often more than 2 mm long, and perfectly truncate.

SUMATRA, *Bartlett 6648a, 7091, 7093; Ramat si Toroes 174; Hancock 43; Yates 1136.* SIBERUT ISLAND, *Boden-Kloss 14600.* BORNEO, *Moulton 205,* of 1914; *Bur. Sci. 2948 native collector.* ANNAM, *Clemens 3015.* The Borneo and Annam collections are not quite typical.

93. TRICHOMANES ASPLENIOIDES Presl. Plate 52, fig. 2; Plate 55, fig. 1.

T. asplenioides PRESL, Hymenophyllaceae (1843) 129; KUNZE, Farnkräuter 218, pl. 89.

T. fronde lineari-lanceolata elongata glabra pinnata, pinnis alternis oppositisque sessilibus oblongis obtusis crenulatis inaequilateralis inferne angustioribus acutis superne latioribus truncatis auriculatis, fructiferis irregulariter fissis aut laceris, venis creberrimis furcatis venulisque crassiusculis, rachi inferne hinc canaliculata hinc tereti, stipite tereti basi hirsuto, rhizomate brevi oblique repente.

Cuming pl. exs. philipp. n. 184.—Presl, loc. cit.

T. fronde coriacea, rigida, . . . parte superiori sorophora; pinnis . . . trapezio-oblongis, curvulis, apice subdilatato obtusis, denticulatis, . . . fertilibus apice s. margine superiori inciso-laceris; involucris cyathiformibus, ore elabiato repandis, semiemersis; . . . rhachi marginata, hirsuta; stipite brevissimo, flexuoso. . . .

Nur an dem oberen Drittheile des Wedels werden die Fiedern fruchttragend, oft nur an der Spitze. Solche fertile Fiedern erscheinen am Vorderrande, bisweilen auch am vorderen Theile des Oberrandes tief, fast bis zur Mitte eingeschnitten und auf den so gebildeten linienförmigen Zipfeln sind die Früchte, in der Zahl von 3–7 an jeder Fieder, befindlich.—Kunze, loc. cit.

Kunze observed also that Cuming's specimens were overripe, which is true of the fronds but not of the plants, which seem to have been immature. This is shown by the weakly developed rhizome, the short stipes, the size of the plants; and the degree of restriction of the sori to the apex of the frond. The sori are always most abundant toward the apex, but may be present at least two-thirds of the way to the base. The fronds of well grown plants are commonly up to 20 cm long, 4 cm wide, on stipes 8 cm long. The longest frond I have measured is 33 cm long, the stipe 15 cm. Fully half of the collections of this species are immature, as plants, with weakly developed caudices, stipes more or less 2 cm long, fronds not over 10 cm, and with

grouped near the apex, even in the best-developed specimens seen, and the lamina is so contracted from their bases that they appear distinctly stalked. Their position is distal, as in *T. asplenioides,* in distinction to acropetal, as in *T. javanicum;* however, the affinity to the latter species is probably the closer. The involucre is large, often more than 2 mm long, and perfectly truncate.

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Nur an dem oberen Drittheile des Wedels werden die Fiedern fruchttragend, oft nur an der Spitze. Solche fertile Fiedern erscheinen am Vorderrande, bisweilen auch am vorderen Theile des Oberrandes tief, fast bis zur Mitte eingeschnitten und auf den so gebildeten linienförmigen Zipfeln sind die Früchte, in der Zahl von 3–7 an jeder Fieder, befindlich.—Kunze, loc. cit.

Kunze observed also that Cuming's specimens were overripe, which is true of the fronds but not of the plants, which seem to have been immature. This is shown by the weakly developed rhizome, the short stipes, the size of the plants; and the degree of restriction of the sori to the apex of the frond. The sori are always most abundant toward the apex, but may be present at least two-thirds of the way to the base. The fronds of well grown plants are commonly up to 20 cm long, 4 cm wide, on stipes 8 cm long. The longest frond I have measured is 33 cm long, the stipe 15 cm. Fully half of the collections of this species are immature, as plants, with weakly developed caudices, stipes more or less 2 cm long, fronds not over 10 cm, and with

sori congested near the apex, often on decidedly reduced pinnæ. These ill-developed specimens are doubtfully if at all distinguishable from *T. javanicum* in the corresponding stages. I assign them to *T. asplenioides* in the Philippines, to *T. javanicum* in Java, the Peninsula, etc., because well-developed individuals from the same regions belong uniformly to one or the other.

Large fronds of *T. asplenioides* are usually narrower than those of *T. javanicum*, with the pinnæ relatively broad and entire. The conspicuous and dependable distinction is in the position of the sori on the pinnæ, tending to occupy the apex in the former, the acroscopic margin in the latter.

Trichomanes asplenioides is the very common representative of the group in the Philippines, common from the Batanes to Basilan, wanting perhaps in Palawan. As there are some eighty collections, I may abstain from enumerating them; all are distributed as *T. javanicum*, to which I refer no Philippine specimen. So common a plant naturally varies, but in this case rarely or never so far that a well-grown specimen could be mistaken for another species; the few doubtful cases will be mentioned in the discussion of *T. atrovirens*.

Beyond the Philippines, there is an Amboina specimen, *Robinson 1964*, with the fructification of *T. asplenioides*, but narrower and more numerous pinnæ than typical plants bear. Until an opportunity to study Celebes material may show the range in that direction, I refer this to *T. asplenioides*, with doubt. *Trichomanes javanicum* is likewise variable where it is common. Rare individuals in such places bear distal sori—examples are *Henderson 18765* and a collection by Burkill in Pahang, and *Achmad 414*, from Simalur Island, near Sumatra; because they are isolated cases, and like *T. javanicum* in other respects, I regard them as aberrant individuals of that species. Finally, there are Bornean collections with some tendency to distal fructification. They are small plants, with short petioles and mostly apical sori, and I have already noted the lack of distinctive character by such plants. Every well developed Bornean specimen I have seen is clearly *T. javanicum*. Still, Borneo is ill known, and *T. asplenioides* may be there; or the two may blend there. If they do, I would still consider it convenient to treat as specifically distinct in the Philippines a plant which, as thoroughly collected as this has been, maintains so well its local distinctive character.

94. TRICHOMANES ATROVIRENS Kunze. Plate 52, fig. 3; Plate 55, fig. 2.

T. atrovirens KUNZE, Bot. Zeit. 5 (1847) 371.
Cephalomanes atrovirens PRESL, Hymen. (1843) 110, pl. 5.
Trichomanes rhomboideum J. SMITH in Hooker's Journ. Bot. 3 (1841) 417, nomen, not *Cephalomanes rhomboideum* van den Bosch, except as to the name-bringing synonym.

The first description of this species is incorporated in that of Presl's genus *Cephalomanes*, of which this is the type species.

Venae pinnatim exorientes, creberrimae, prominulae, uni-bifurcatae, venulisque sterilibus apice obtuso liberae. Sorus in dentibus frondis obliteratis terminalis, pedicellatus. Indusium cylindraceum, limbo patente integro. Receptaculum indusio dimidio duplove longius, rectum, rigidulum, cylindricum, apice in globum incrassatum, basi capsuliferum. Capsulae sessiles, lenticulares.

Rhizoma . . . stipitibus aut illorum residuis aggregatis radicibusque duas trientes lineae crassis filiformibus flexuosis rigidis tam arcte obtectum, ut vix aut non conspicitur. Stipites pollicares, semilinea paulum crassiores, teretes, paleis piliformibus fuscis flexuosis usque sesquilineam longis adspersi, demum glabrati. . . . Frons (in strictissimo sensu) sex-septempollicaris, pollicem lata aut angustior, arcuato-subfalcata, exsiccata nigricans, lineari-lanceolata, acuta, basi angustata, pinnata. Pinnae (exceptis infimis paullo distantibus) contiguae, alternae, petiolulo vix semilineali insidentes, oblongae, rotundato-obtusae, inaequilaterae, latere superiori latiore basi truncato . . . latere inferiore duplo angustiore laciniato basi acuto vel acutissimo . . . laciniis sinu lato interceptis anguste linearibus (exsiccatione apparenter setaceis) acutis simplicibus aut subinde bilobis, lobis divergentibus. . . . Sori solummodo in margine superiori pinnarum . . . pedicello brevissimo quamquam bene conspicuo insidentes. Indusium linea paululum longius, cylindraceum, basi acutum, limbo brevissimo patente integro. . . .

. . . insulas Philippinas inhabitat . . . Cuming . . . numero 169 . . .—Presl, loc. cit.

The "more or less thickened" tip of the receptacle is not always present, and I have never seen it as large and perfectly spherical as Presl figured; and similarly enlarged tips are sometimes evident on other species of the group. The slightly dilated mouth of the involucre is almost always present, but not invariably. The margin is always laciniate dentate, with a few notably long, lashlike laciniæ on the basiscopic margin, sometimes deflexed, but, when longest, bent upward across the pinna; but such margins are occasionally found, only less accentuated, on other species, especially on the form of *T. javanicum* which van den Bosch identified with the Philippine plant.

While none of these more minute distinctions is absolutely distinctive, *T. atrovirens* is readily recognizable by its narrow,

very compact fronds, with very numerous small, imbricate pinnæ, dark color, and thin texture. The stipes are characteristically short, commonly 1 to 3 cm long, with well developed fronds 20 cm long and 2.5 cm wide.

Although far from as common as *T. asplenioides*, this is not a rare species in the Philippines, occurring the length of the Archipelago. Collections are: *Cuming 169*, in most herbaria (in my own, this number is *T. asplenioides*); *Weber 1544*, Cagayan Province; *For. Bur. 2397 Borden, Williams 148, Merrill 3121, Copeland 206, Elmer 6880*, all from Mount Mariveles, Bataan Province; *Copeland s. n.*, Cavite; *Bur. Sci. 1810 Ramos*, and *Bur. Sci. 48848 Edaño*, Rizal Province; *Williams 2039* and *Elmer s. n.*, Laguna Province; *Bur. Sci. 20696 Escritor*, Tayabas Province; *Bur. Sci. 48365 Ramos & Edaño*, Alabat Island; *Elmer 12484*, Sibuyan; *Bur. Sci. 17606 Ramos, Bur. Sci. 24772 Edaño*, Samar; *Bur. Sci. 35372 Martelino and Edaño, Bur. Sci. 42357 Edaño*, Capiz Province; *Bur. Sci. 41742 Edaño*, Leyte; *Bur. Sci. 42980 Ramos*, Bohol; *Bur. Sci. 35150 Ramos and Pascasio*, Dinagat Island; *Wenzel s. n.* Surigao. Specimens combining the characters of *T. atrovirens* and *T. asplenioides* are *Copeland 207* and *Topping 810*, from Mount Mariveles, and *Wenzel 173;* they may be hybrids.

Bur. Sci. 578 Foxworthy, from Palawan, has the color, the congested, stipitulate pinnæ, and long basal hairs of *T. atrovirens*, but has comparatively entire margins and long stipes; although a large plant, it bears few sori. It may be a distinct species; or is possibly to be referred to *T. javanicum.*

NEW GUINEA, *Bavaler 210*, in Bureau of Science herbarium; *Lauterbach 521*, in the Singapore herbarium; *Werner 52; Brass 677, 1482.* QUEENSLAND, as attested by the figure of *"Trichomanes javanicum"* in Bailey's Lithograms of the Ferns of Queensland, pl. 24, left.

Trichomanes Ledermanni Brause, Bot. Jahrb. 56 (1920) 35, known to me by description only, seems to be a small *T. atrovirens.* The latter is said to be distinguished by stronger and larger, longer-petioled fronds, with irregularly toothed acroscopic margins and more numerous bristlelike teeth on the basiscopic margins, more closely placed nerves, and cylindrical sori with shorter receptacles. But, like all of the group it can be fertile while far from fully developed in size; it is characterized by short stipes; may be perfectly regularly dentate on the acroscopic margin, and has usually few bristles (in distinc-

tion to *Cephalomanes rhomboideum* as figured by van den Bosch). Brause may have had van den Bosch's plant in mind.

Trichomanes maluense Brause, Bot. Jahrb. 56 (1920) 36, also unknown to me save by description, is another small fern of the same group. The fronds, up to 10 cm long, are fertile through two-thirds of their length, and with as many as nine sori to the pinna or segment. They are described as pinnatifid, and the divisions are called segments, which, if accurate, distinguishes the species from others; but later in the diagnosis we find "rachibus teretibus, glabris, angustissime alatis," seeming to apply to a pinnate frond.

95. TRICHOMANES DENSINERVIUM Copeland. Plate 53, fig. 1.

Trichomanes densinervium COPELAND, Philip. Journ. Sci. 6 (1911) Bot. 71.

Cephalomanes stipite valido vix 10 cm alto, fronde 18 cm alta, vix 4 cm lata, sursum sensim angustata, pinnis proximis valde imbricatis, infimis haud remotis, obliquis, apice rotundatis, ciliatis, venis angulo acuto orientibus, proximis, crassis, furcatis et inferioribus acroscopicis iterum furcatis; soris partem superiorem frondis occupantibus, acroscopicis, ad pinnam quamquam usque ad 8, uniformibus, indusiis compresso-infundibuliformibus, truncatis, limbo paullo dilatato vel interdum recto, receptaculo exserto.

[New Guinea, *King*] *No. 150.*

Differs evidently from *T. javanicum* Bl., *T. atrovirens* Kze., and *T. Zollingeri* v. d. B. in the coarse veins, which stand at a much more acute angle to the costa. The frond is also conspicuously more compact and the pinnae more rounded.—Copeland, loc. cit.

The congested, broadly imbricate pinnæ, the position of the sori on the pinnæ, and the shape of the involucre, are all as in *T. atrovirens,* which I recognize as a New Guinea species. *Trichomanes densinervium* is distinguished by much more coriaceous and less cut pinnæ, long stipe, and the aggregation of the sori toward the apex of the frond. It is known only by the type collection.

96. TRICHOMANES KINGII Copeland. Plate 53, fig. 2.

Trichomanes (*Cephalomanes*) *Kingii* COPELAND, Philip. Journ. Sci. 6 (1911) Bot. 72.

Rhachi anguste alata, glabra; pinnis laceratis; paniculo breve; indusio conico, vix 2 mm alto, 1 mm vel ultra lato, limbo haud dilatato; aliter praecedenti [T. acrosoro] simile.—Copeland, loc. cit.

New Guinea, Lakekamu, collected by Copland King.

This species was described from a single old frond, too worn to be really fit for description. It is impossible to say how completely its age may have been responsible for the lacera-

tion of the pinnæ. A winged rachis, however, would disappear, if affected at all by age. This, and the stalked sori, seem to distinguish *T. Kingii* from the many imperfectly developed forms of *T. javanicum.*

97. TRICHOMANES ACROSORUM Copeland. Plate 53, fig. 3.

Trichomanes (Cephalomanes) acrosorum COPELAND, Philip. Journ. Sci. 6 (1911) Bot. 72.

Stipitibus confertissimis 1–2 cm altis; fronde 6–10 cm alta, 1.5–2 cm lata, rhachi pilosa glabrescente; pinnis 10–12 mm longis, basi cuneatis, apice rotundatis, dentatis et interdum partitis, venatione sublaxa; pinnis supremis fertilibus, 1–3-soratis, lamina carentibus, indusio 2.5–3 mm longo, infra limbus plus minus dilatatum vix 1 mm crasso; receptaculo usque ad 7 mm exserto.

[New Guinea: *King*] *No. 352,* Lakekamu.

The racemose or narrowly paniculate sori make this very distinct from any species hitherto known.—Copeland, loc. cit.

Known only by the type collection. The restriction of the sori to the apical region is characteristic of small—that is, immature—individuals of the larger species, notably of *T. javanicum* and *T. asplenioides.* But so distinctly spikelike a fertile region, with such elimination of the lamina of the fertile pinnæ, does not occur in any other species, even in *T. sumatranum;* and this species has very different involucres.

98. TRICHOMANES BORYANUM Kunze. Plate 52, fig. 4.

T. boryanum KUNZE, Farnkräuter (1847) 237, pl. 97.

Cephalomanes australicum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 139; Journ. Bot. Néerl. 1 (1861) 341.

Cephalomanes Wilkesii VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 140; Journ. Bot. Néerl. 1 (1861) 345.

T. fronde tenui, subcoriacea, pellucidula, glabra, curvato-lanceolata, obtusiuscula, pinnata, dimidio superiore sorophora; pinnis breviter petiolatis, approximatis, trapezio-oblongis, subfalcatis, obtusis, basi sursum truncata, deorsum cuneata in petiolum et superne ad rhachin decurrentibus, sterilibus dentatis, subincisis; fertilibus in medio marginis superioris profunde inciso-laciniatis, laciniis sorophoris; involucris poculiformibus, marginatis, ore dilatato, subbilabiato repandis; receptaculo cylindrico, exserto; rhachi marginata, apice subalata petiolisque sparsim setoso-paleaceis; stipite brevi, versus basin setoso-paleaceo; rhizomate erecto, brevi, caespitoso, radicoso.

Trichomanes alatum Bory. . . . (non Swartz).

Diese Art wurde bis jetzt nur auf Ualan. . . . einer der Karolinien, beobachtet.—Kunze, loc. cit.

There are one or two derived synonyms for each original synonym noted.

The essential distinction from all Malayan species is provided by the flaring mouth of the involucre, which is not at all bilabiate, nor so figured by Kunze. The involucre may be slightly immersed at the base, or sessile, or distinctly stalked. It can usually be seen to be slightly winged, even if stalked. Kunze described and, in the enlargement, figured it as widened gradually from the bottom; if this is accurate and constant, his species is distinct from that of Fiji, etc., which is then *T. australicum;* but I mistrust this feature, because it is not so drawn in Kunze's natural-size figure, and specimens from Yap, *Volkens 161, 362,* have them widened immediately above the base to a tube, which then widens but little up to the dilated mouth. Sori are usually wanting on the lower half of the frond. They are borne on the acroscopic side, not on the tip, of each fertile pinna. Where they stand, the lamina is cut back fully halfway to the costa, as correctly shown by Kunze in his "Habitus" sketch, but not in his enlargement—another reason for my mistrust of the latter.

The range in size is as in Malayan species. The frond is commonly rather thinner, with more regularly and narrowly oblong pinnæ, and less dissected margin, but these features are not at all constant. Van den Bosch described *C. Wilkesii* as with minutely dentate margin, and *C. australicum* as with upper margin obtusely, the lower one acutely dentate or setaceous. Rarely, however, Fiji specimens bear basiscopic projections (*Parks 20033*); and Samoan plants more often do so, or have the apices shallowly lacerate. New Hebrides specimens may exactly conform to the description of *C. australicum* (*Matheson,* Tanna), or may do so except that the sori are not at all immersed (*Kajewski*).

Guam, *Agr. Exp. Stat. 27,* mouth not greatly dilated, thus varying toward *T. atrovirens;* Carolines (New Caledonia, type locality of *C. australicum*); New Hebrides; Fiji and Samoa, common. Australian specimens doubtfully referred to this species have the lip less dilated and the margin minutely but more deeply cut than is typical.

99. TRICHOMANES FOERSTERI Rosenstock.

Trichomanes Foersteri ROSENSTOCK, Fedde's Repert. 13 (1914) 213.

Cephalomanes e grege *T. javanici* Bl., cum forma typica, a cl. v. d. Boschio in Hymen. javan., p. 31 descripta, omnino congruens, sed soris praes-

ertim apices pinnarum mediarum et inferiorum occupantibus, in pinnis superioribus ex apice secus marginem anteriorem plus minusve longe decurrentibus, indusiis usque ad apicem utrinque anguste marginatis, orificio dentibus papillosis c. 20–25 numero, 2–3-ies longioribus quam latis distincte ornato ab eo et ab affinibus diversa.

Sumatra occidentalis, c. 800 m alt., in alveis haud rara, 1913, I. W. Grashoff no. 43.—Rosenstock, loc. cit.

This must be a very distinct species, but I have seen no specimen. The involucres are described as bearing a crown like that of *T. superbum;* this might be deciduous, but I have seen no sign of such a structure in any *Cephalomanes.* The position of the sori on the several pinnæ is as in *T. asplenioides;* but the restriction of the fertile pinnæ to the middle and lower part of the frond is very remarkable.

100. TRICHOMANES MADAGASCARIENSE Moore.

T. madagascariense MOORE, Index (1861) 230.

Cephalomanes Madagascariense VAN DEN BOSCH, Synopsis (1859) 11.

Fronde oblongo-lanceolata pinnata, pinnis inferioribus horizontalibus contiguis, superioribus mediisque divaricatis cunctis breviter petiolatis e basi lata cordata inaequali oblongis, margine inaequaliter dentato-serratis, apice rotundatis, venulis remotiusculis 1–2 furcatis; cellulis maximis teneris elongatis hexaedris, parietibus rectis hyalinis, interaneis amorphis fuscescentibus seriatim radiatimque dispositis; soris subimmersis, mediotenus latius superne anguste marginatis, indusio cylindrico parum ventricoso, ore dilatato patulo recto.

Stipes triqueter glaber 0,1 et ultra longus, frons tenuis diaphana olivacea 0,15–0,18 longa, 0,03–0,04 lata, pinnae 0.010–0,016 longae, 0,006–8 latae.

Habitu et statura convenit cum *C. Zollingeri* et *C. curvato,* sororum forma cum *C. rhomboideo.*

Hab. Madagascar. Boivin in Herb. de Franqueville.—Van den Bosch, loc. cit.

The cordate pinnæ should distinguish this species clearly from all others known.

101. TRICHOMANES CRASSUM Copeland sp. nov. Plate 54; Plate 55, fig. 3.

Cephalomanes fronde longissima pinnatifida, caudice erecto breve; stipitibus fasciculatis, 1 ad 2 cm longis; fronde lineare, usque ad 40 cm longa, 4 ad 5 cm lata, utrinque angustata, ad alam costae sursum latam deorsum angustam ad pedem obsoletam pinnatifida, sordide atroviride, opaca, costa seu rhachi valida setis atrocastaneis deciduis vestita; segmentis patentibus oblongis, maximis 3 cm longis, 5 mm latis, obtusis, hic denticulato-crenatis, illic subintegris, margine inferiore facile revolutis, venis (cum affinibus comparatum) tenuibus et subremotis;

cellulis in gregi ob magnitudinem cellularum insigne tantum enormibus. Sori desunt.

Ins. Leyte Philippinensem habitat, ubi lexit *G. Lopez*, sub *Bur. Sci. no. 40804*. Typus in herb. Bur. Sci.; specimina etiam in U. S. Nat. Herb. et herb. auctoris.

Evidently a member of this group, but its most distinct species. Only so isolated a specimen would constrain me to describe it without fruit. The frond suggests *Athyrium porphyrorhachis*, or a *Polypodium* of the *P. pectinatum* group.

14. ABRODICTYUM; THE MONOTYPIC GROUP OF T. CUMINGII

102. TRICHOMANES CUMINGII C. Christensen. Plate 56, figs. 1 and 2.

T. Cumingii C. CHRISTENSEN, Index (1906) 638.

Abrodictyum Cumingii PRESL, Hymen. 113, pl. 7, diagnosis specifica in generica, p. 112, incorporata.

Habrodictyon Cumingii VAN DEN BOSCH, Hymen. Jav. 17, pl. 12.

T. Smithii HOOKER, Ic. Pl. pl. 704; Sp. Fil. 1: 138.

Venae prominulae, ramosae. Venulae crebrae, tenuissimae, flexuosae, in maculas irregulariter oblongas anastomosantes, ramosae, venulis secundariis pone marginem longitudinaliter decurrentibus, aliis intra maculas brevibus liberis obtusis. Cellulae intra maculas transverse lineari-hexagonae. Sorus exsertus, pedicellatus. Indusium infundibuliforme, limbo patente vel patentissimo integerrimo. Receptaculum indusio triplo longius, setaceum, basi capsuliferum. Capsulae sessiles, lenticulares. . . .

Incolit . . . insulas Philippinas, . . . Cuming . . . 208 et 358.—Presl, loc. cit.

Presl's description is better than his diagnosis (just quoted), but need not be quoted; botanists agree, as stated by van den Bosch, that "Phantasie magis quam veritati indulsisse videtur Cl. auctor."

Epiphytic on tree-fern trunks; rhizome short, its apex protected by a mass of castaneous bristles; stipes densely caespitose, 1 to 6 cm long, dark, wiry, bristly at the base; frond up to 27 cm long and 5 cm wide, commonly 10 cm long, sparingly tripinnatifid when well developed, commonly bipinnatifid, the rachis narrowly winged upward, or throughout on small forms, the lowest pinnæ reduced. The distal segments of the upper part of the frond commonly elongate, up to 2 cm long, and a scant millimeter wide; sori on short lateral segments throughout the frond; involucre campanulate to (usually) cylindrical, winged, with flaring and undulate mouth.

The salient characteristic is the cellular structure. Excepting the marginal, and in places the submarginal cells, the laminar cells are elongate at right angles to the axes of the seg-

ments, and are placed side by side in irregularly longitudinal rows tending to converge on the veins. The walls bounding these rows of cells were mistaken for veinlets by Presl. The veins are very slender, and false veinlets are absent. The walls are thickened and pitted in a manner suggesting the group of *T. rigidum,* to which, however, there is no near affinity. The pitting of the walls escaped van den Bosch; he may have figured a Tidore specimen, and it may be absent there.

Common in moist, tree-fern country, from northern Luzon to southern Mindanao and Palawan. Reported from the Moluccas (van den Bosch).

15. MACROGLENA; THE GROUP OF TRICHOMANES MEIFOLIUM

This collection of species is probably not one group, in the proper sense in which the word is used elsewhere in this treatise. The species have in common coarse rhizomes, whether creeping or erect, and very finely dissected fronds. Most species have notably large laminar cells, and many are brownish in color, with brownish cell contents closely appressed to the walls. Also, most species have more or less coarsely pitted walls. Both *T. setaceum* and *T. caudatum* and some relatives seem to be related to the group of *T. rigidum,* but this affinity may well be along independent lines.

Two early-described species, *T. parviflorum* and *T. angustatum,* are unknown to me; they may be represented by synonyms in my presentation. As the former was described from the region under review, its diagnosis and description are reproduced here.

TRICHOMANES PARVIFLORUM Poiret in Lamarck, Dict. Enc. 8 (1808) 83.

Trichomanes frondibus subtripinnatis; pinnulis pectinatis, petiolis hirsutis, fructificatione minimâ, incisuris inferioribus terminante.

. . . Ses racines sont composées de longues fibres épaisses, noirâtres, fasciculées: il s'en élève plusieurs feuilles pétiolées, droites, longues d'un pied, presque trois fois ailées, glabres, d'un vert-foncé, ovales-lancéolées, acuminées, composées de folioles alternes, rapprochées, lancéolées, acuminées; les pinnules alternes, divisées en découpures très-fines, simples ou bifides, capillaires, aiguës; les pétioles bruns, cylindriques, roides, chargées de poils fins, alongés, noirâtres. La fructification est fort petite, en forme d'entonnoir, située à l'extrémité des découpures inférieures; la columelle fine, saillante.

. . . Madagascar par M. du Petit-Thouars.—Poiret, loc. cit.

Key to the species.

Fronds fascicled.
- Segments linear.
  - Walls conspicuously pitted ..... 103. *T. strictum.*
  - Walls not or hardly pitted ..... 111. *T. Schlechteri.*
- Segments setaceous.
  - Pinnules with undissected central area ..... 104. *T. setaceum.*
  - Dissection of fronds complete.
    - Walls thickened and pitted ..... 105. *T. laetum.*
    - Walls thin ..... 110. *T. meifolium.*

Rhizome creeping.
- Segments typically setaceous, squarrose ..... 110. *T. meifolium.*
- Segments linear, not squarrose.
  - Lateral walls thickened and pitted.
    - Pinnæ (or some of them) caudate ..... 106. *T. caudatum.*
    - Pinnæ not caudate ..... 107. *T. flavo-fuscum.*
  - Walls slightly, irregularly thickened.
    - Thickening reticulate ..... 108. *T. Asae Grayi.*
    - Thickening nodulose ..... 109. *T. compactum.*
  - Lateral walls uniformly thin ..... 112. *T. gemmatum.*

103. TRICHOMANES STRICTUM Menzies. **Plate 56, figs. 3 and 4.**

T. strictum MENZIES, ex Hooker and Greville, Ic. Fil. (1831) pl. 122.

T. rigidum var. *strictum* FIELD, N. Z. Ferns 72, pl. 28, fig. 3.

T. leptophyllum A. CUNNINGHAM, Comp. to Bot. Mag. 2 (1836) 368.

Fronde lanceolata stricta pinnata, pinnis lanceolatis sub-bipinnatifidis, laciniis linearibus obtusis laxe reticulatis glabris integerrimis, involucris cyathiformibus ore aperto truncato integro, rachi marginata, stipite nudo.

Trichomanes strictum. *Menzies MSS.*

HAB. In sinu, Dusky Bay dicto, apud Novam Zeelandiam. *Menzies.*

Caudex, ut videtur, brevis, crassus . . . .

Stipes digitalis, erectus, strictus, fuscus, teres, nudus.

* * * * * * *

Sori rari, in singula pinna 1 vel 2, versus basin exteriorem segmentorum inferiorum inserti, laciniam brevem terminantes.

Involucrum cyathiforme, vix marginatum, ore dilatato, truncato, integro.

. . . It is very distinct from any species we are acquainted with.—Hooker and Greville, loc. cit.

Stipes fascicled on a short, erect caudex, 5 to 8 cm tall, wiry, naked; fronds 10 to 15 cm long, lanceolate or lanceolate-ovate, with the lowest pinnæ usually but not always reduced, tripinnatifid, segments close but not numerous, about 0.5 mm wide, the lamina decurrent and forming a narrower wing on the rachis

and upper part of the stipe; laminar walls thick and coarsely pitted; sori on the lowest acropetal segments of the lowest acropetal pinnules, sessile, involucre cylindrical, winged, truncate, receptacle long-exserted.

New Zealand only.

The fascicled stipes, involucre, and wall structure mark this as a relative of the group of *T. rigidum*, but it is very distinct in appearance because of the fine and uniform dissection of the frond, the wing being as wide on the segments as on any of the coarser axes.

I have seen no New Zealand specimen named *T. leptophyllum*, and do not expect to unless it be very old, as all New Zealand botanists for the past eighty years have regarded it as completely identical with *T. strictum*. New Caledonia plants reported and distributed as *T. leptophyllum* are *T. caudatum*, with creeping rhizomes.

104. TRICHOMANES SETACEUM van den Bosch. Plate 57, fig. 1.

T. setaceum VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 176; Journ. Bot. Néerl. 1 (1861) 360.

T. trichophyllum MOORE, Gard. Chron. (1862) 45.

T. Merrillii COPELAND, Philip. Journ. Sci. 1 (1906) Suppl. 144, pl. 1.

Fronde oblonga acuminata bipinnata, pinnis divergentibus, infimis saepius reversis, contiguis oblongis vel oblongo-lanceolatis, pinnulis erecto-patulis subcontiguis oblongis lanceolatisve pinnatifidis, laciniis arcte contiguis strictis furcatis simplicibusve, lacinulis angustissime linearibus alte connatis inaequalibus in setam flexam curvatamque abeuntibus, rhachi valida dense palaceo-hirsuta, venis tenuibus, venulis densissimis parallelis, cellulis magnis firmis opacis elongato-hexaëdris, parietibus hyalinis acute crenulatis (quasi spinulosis), interaneis amorphis spissis diffusis ex aureo obscure fuscis, soris in laciniis pinnularum infimis axillaribus parvis emersis, indusio vix conspicue marginato compresso cylindrico-infundibuliformi orificio recto, stipitibus e rhizomate brevissimo adscendente polyrrhizo fasciculatis in basin fusco-pilosam incrassatis glabrescentibus 10–18 cent. longis. Frons 15–20 cent. longa, 5–7 lata rigidula gracilis ex obscure viridi olivacea.

* * * * * * *

Hab. Singapore, GAUDICHAUD (H. Berol.); Ins. Banca (pr. Mintole.), AMAN.—Van den Bosch, loc. cit.

The rhizome of well developed plants is stout and erect, concealed by a mass of roots and stipes; stipes densely and fairly permanently bristly, ranging on fertile fronds from 3 to 16 cm in length; fronds 10 to 20 cm long, lanceolate to oblong, the basal pinnules sometimes reduced and sometimes deflexed; pinnæ imbricate, broadly elliptic, obtuse; pinnules pinnate to a winged axis, into secondary pinnules pinnatifid to a restricted

axial lamina with many long, setaceous segments; laminar walls thick, with large pits, appearing zigzag or toothed in exact focus, the frond thus having the texture of the less coriaceous members of the *T. rigidum* group, but still being harsh because composed mostly of the axes.

I have seen no authentic specimen of *T. trichophyllum*, but the original description is perfectly appropriate to large specimens of this species. The *T. trichophyllum* of Baker, Syn. Fil. 2d ed. 466, is redescribed to fit a very distinct plant of New Caledonia, *T. laetum*.

It was my former impression that *T. setaceum* (as *T. Merrillii*) was intermediate between *T. obscurum* and *T. meifolium*, and perhaps also between *T. obscurum* and *T. javanicum* with *T. rhomboideum* as another intermediate in the latter series. It may be, however, that it has no affinity except to the *T. rigidum* group; and that *Cephalomanes* and *Macroglena* are independent derivatives of the group of *T. radicans*.

BORNEO, common in Sarawak and British North Borneo, *Burbidge; Hose; Ridley; Bur. Sci. 2504 native collector; Clemens 9493, 22019; Ramos 1121, 1319; Bartsch 189; Topping 1369.* PERAK, *Murton.* PHILIPPINES, Palawan, *Merrill 716* (type of *T. Merrillii*).

105. TRICHOMANES LAETUM van den Bosch. Plate 57, fig. 2.

T. laetum VAN DEN BOSCH, Ann. Sci. Nat. IV 15 (1861) 90; FOURNIER, Ann. Sci. Nat. V 18: 260.
T. trichophyllum BAKER, Syn. Fil. 2d ed. 466 partim, non Moore.
T. Marierii VIEILLARD in herb., and in Baker, loc. cit., nomen nudum.
T. Luerssenii F. v. MÜLLER in Luerssen, Bot. Centralb. 9 (1882) 440.

Fronde lanceolata tripinnatifida, laciniis erecto-patulis contiguis (tertiariis appressis), lacinulis setaceis elongatis flexuosis, cellulis fere hyalinis parvis irregularibus punctulatis amoene viridibus minute globulosis acute crenulatis, serie 1 vel 2 utrinque juxta venulas laciniarum laminam constituentibus, soris in laciniis secundariis axillaribus subsessilibus anguste cylindricis, limbo parumper constricto. Rhizoma adscendens valde radiculosum fusco-hirsutum stipites valde approximatos (5–8 centim. longos) flexuosos angustissime alatos, pariter ac rachis compressa, frondi concolores emittens; frons 10–12 centim. longa, 3–4 lata rigida viridis.

Hab. ad filicum caudices, Balade [New Caledonia] VIEILLARD, herb. n. 1665.—Van den Bosch, loc. cit.

Reduced to "T. Pluma vel T. trichophyllum" in Christensen's Index.

Rhizome ascending and finally erect, covered by roots and stipes in the manner of the group of *T. rigidum;* stipes maroon,

wiry, glabrescent; fronds lanceolate, or ovate if dwarfed, two to four times pinnate and the pinnules repeatedly dichotomous, the ultimate segments exceedingly fine, and spreading in all directions, with the aspect of an exceptionally finely dissected *T. meifolium;* lamina 1, rarely 2, cells wide, or wanting, all walls thick, coarsely and conspicuously pitted; sori much farther from the main axes than in *T. meifolium,* but still not nearly reaching the outline of the frond; involucre short- or long-cylindrical, mouth commonly slightly bilabiate without being dilated.

NEW CALEDONIA, *Vieillard 2139; Franc 473, Rosenstock Fil. Nov. Caled. 29; le Rat 293,* in part.

However similar in aspect to compact specimens of *T. meifolium,* this species may not be even its near relative. The fascicled stipes, position of sori, and form of involucre, and the pitting of the walls, altogether, establish a more certain affinity to the group of *T. rigidum.* I have construed this species by *Vieillard 2139,* represented in the Gray Herbarium and in the herbarium of the Bureau of Science; it is the only Vieillard specimen cited by Fournier.

Trichomanes Luerssenii was described from the New Hebrides, and compared with six other species, but not with *T. laetum.* The description is good enough to seem to establish its complete identity.

106. **TRICHOMANES CAUDATUM Brackenridge. Plate 57, figs. 3 to 5; Plate 58, fig. 1.**

T. caudatum BRACKENRIDGE, U. S. Expl. Exped., Bot. 16 (1854) 256, pl. 36, fig. 5.

T. Milnei VAN DEN BOSCH, Ann. Sci. Nat. IV 15 (1861) 89.

T. leptophyllum FOURNIER, BAKER, CHRISTENSEN, as to N. Caledonia.

HAB. Tahiti, Society Islands: on trees in mountain forests.

Rootstock short and thick, creeping, densely *tomentose* with brownish short hairs. *Stipe* about 2 inches long, *terete* slightly *rough* to the touch. *Fronds* very graceful, and in a dry state quite *elastic,* 10 to 15 inches long by 3 inches broad, *elongated-lanceolate, pinnate,* and as well as the *oblong-lanceolate* and *bipinnatifid pinnæ* (which are rather *distant at the base*) tapering into a narrow, *tail-like,* serrate point. Pinnules or secondary divisions approximate and somewhat imbricated; the ultimate ones less so; these are *narrow-linear,* short and *obtuse,* their apices either *simple or bifid. Rhachis* round at the base, *narrowly-winged* upwards, and slightly scabrous on the under side. Veins throughout very thick and prominent. Sori copious all over the frond. *Indusium cylindrical,* with an *attenuated base* and a *spreading, entire mouth,* seated on a short *supra-axillary* lacinia, or else *terminal, partially* immersed, or with *two wings,* which are sometimes

so narrow as scarcely to be perceptible. *Receptacle exserted*, about twice the length of the indusium, and quite straight.

This is closely related to the *T. angustatum* of Carmichael, as figured in Hooker and Greville's Icones Filicum.—Brackenridge, loc. cit.

The type collection seems to have been a single frond, since it is not represented in the Gray Herbarium. It represents the species in its fullest and most symmetrical development. Most Tahiti collections have the larger fronds about 20 cm long, with the caudate pinna tips developed here and there on the frond; and on small fronds these tips may not be very elongate on any pinnæ. These small and middle-sized fronds are perfectly duplicated by specimens from Fiji, and by the larger specimens from New Caledonia, received as *T. leptophyllum* and *T. Milnei*, the last averaging the smallest.

Rhizome creeping, 1 to 1.5 mm in diameter, with stipes 1 cm or more apart; stipes 2.5 to 5 (rarely to 10) cm long, slender, terete, naked. The walls of laminar cells are moderately thickened, and conspicuously pitted; the cells larger and the pits smaller than in the group of *T. rigidum*, to which there is resemblance and probable affinity. In both Tahiti and New Caledonia material I find the pits commonly larger than they are figured by Mettenius, Hymenophyllaceae, pl. 3, figs. 5, 49, 50. The brownish content of the cell is applied en masse to some of the lateral walls, most often the longitudinal, on one or both sides of the cell, producing under low magnification the appearance of false veins. This is responsible for the statements, Fournier, Ann. Sci. Nat. V 18: 254, Copeland, Bishop Mus. Bull. 59: 26, that the cellular structure suggests *Abrodictyum*. However, I have seen instances, in this group and in *T. dentatum*, in which the pits happen to be in transverse rows, the resemblance to *Abrodictyum* then being real.

In spite of the difference in rhizome, *T. caudatum* and *T. strictum* are surely related. In the original descriptions, both were compared with *T. angustatum* Carm., known only from Tristan d'Acunha, which I have never seen. *Trichomanes tenerum* Spr., of South America, which has been suspected of being *T. angustatum*, is no relative of this Polynesian group (it is near *T. pyxidiferum*); but it would not surprise me, in spite of its geographical remoteness and the bilabiate involucre described for it, to find *T. angustatum* identical with either Polynesian plant.

TAHITI, *Brackenridge* (the type), *Vesco, Setchell and Parks 538, Grant 4222.* RAROTONGA, *Wilder 1050.* SAMOA, *Whitmee.*

FIJI, *Seemann 783, Horne 520, Prince, Parks 20770, 20808 partim.* NEW CALEDONIA, *Le Rat 275, 2848, Cribs 481, Franc 68, Rosenstock, Fil. Nov. Caled. 136.* QUEENSLAND, *Simmonds, Schneider, White.*

107. TRICHOMANES FLAVO-FUSCUM van den Bosch. Plate 58, fig. 2.

Trichomanes flavo-fuscum VAN DEN BOSCH, Ann. Sci. Nat. IV 15 (1861) 88.

Fronde e rhizomate horizontali validissimo fasciato-contorto rubro-fusco-tomentoso ovato-lanceolata inferne pinnata, superne pinnatifida, laciniis 2–3 pinnatifidis erecto-patulis, primariis remotis, secundariis contiguis, lacinulis appressis abbreviatis linearibus, cellulis teneris magnis poroso-punctatis minutissime denticulatis flavis, marginalibus aurantiacis, soris numerosissimis in laciniis ultimis axillaribus lateralibusque urceolatis parvis anguste marginatis, stipite (usque 6 centim. longo) valido terete, rachi superne anguste alata badio-fusca. Frons 2 decim. circiter longa, supra basin 10 cent. lata, dehinc sensim angustata e flavescente obscure viridi-fusca.

Hab. Ad caudices filicum arborescentium in M. de Balade [New Caledonia], Vieillard, herb. n. 1653, 1655 et 1656.—Van den Bosch, loc. cit.

This has been reduced to *T. caudatum* by Luerssen, Baker, and Christensen. It is near to that species but is a distinctly less delicate fern, with stouter stipe, firmer, broader, more compact frond, a deep, dark brown in color, and at most acuminate but not caudate pinnæ. As far as I know, no author has tried to combine this with *T. Milnei,* which seems to me to be merely a small *T. caudatum.*

NEW CALEDONIA, cotype, bearing all three numbers cited by van den Bosch, in Herb. Bur. Sci.; *Cribs 482* (as *T. caudatum*); *Le Rat 955* (as *T. caudatum*); *Franc 344, Rosenstock, Fil. Nov. Caled. 6* (as *T. elongatum*).

108. TRICHOMANES ASAE-GRAYI van den Bosch. Plate 61, fig. 1.

T. Asae-Grayi VAN DEN BOSCH, Ned. Kruid. Arch. 5 (1861) 180; Journ. Bot. Néerl. 1 (1861) 362.

T. ericoides DRAKE, Flore Polyn. Franc. 275, whether or not of Hedwig.

T. longisetum BRACKENRIDGE, and CARRUTHERS, Fl. Vitiensis 344, non Bory.

T. asae grayi; T. longisetum Brack. (non Bory) in WILK. expl. exped. XVI p. 260.

T. gemmato proximum, neque *T. longiseto* . . . affine; ab illo autem distinguatur; fronde minus divisa angustiore graciliore, laciniis primariis basi quidem strictis, sed mox divergentibus recurvisque imbricatis, secundariis erecto-strictis pinnatifidis (nunquam bipinnatifidis), lacinulis ⅓ angustioribus evidentius membranaceis subcontiguis strictiusculis (ultimis nunquam forcipatis), cellulis mediocribus vix magnis (in illo maximis oculo

nudo fere distinguendis) parietibus minute denticulato-crenulatis, soris ½ minoribus ex urceolato cylindricis, ore integro recto.

* * * * * * *

Hab. Ins. Fidchi (ad truncos in sylvis montanis rarum), WILKES.—Van den Bosch, Ned. Kruid. Arch. 5 (1861) 180.

The cotype in the United States National Herbarium is without rhizome, as is also a Samoa specimen, *Jansen*, in the Singapore herbarium. *Quayle 47*, from Tahiti, has an erect, but somewhat elongate and contorted rhizome with the stipes not closely fascicled. All are certainly one species, distinguishable from *T. gemmatum* by having the laminar walls slightly reticulate-thickened; the Fiji and Tahiti specimens are alike in having more slender involucres, but the Samoa one has these as in *T. gemmatum*. Other Samoa specimens too similar to this to be safely distinct have uniformly thin walls, and are regarded as *T. meifolium*. It is possible that all these ought to be called *T. parviflorum;* not being sure what that species is, I let them stand as *T. Asae-Grayi*. The frond is as broad as that of *T. gemmatum*, or broader.

109. TRICHOMANES COMPACTUM v. A. van Rosenburgh in herb. Plate 59.

Caudice valido, adscendente, basibus stipitum radicibus et setis atrocastaneis densis profunde obtecto; stipitibus fasciculatis, 10 cm altis, praecipue deorsum dense squarroso-setosis; fronde 25 cm alta, 8 cm lata, 3- ad 4-pinnatifida, rhachi valida castanea setosa; pinnis subpatentibus usque ad 9 cm longis, 10 ad 14 mm latis, sessilibus, acuminatis; pinnulis imbricatis; segmentis proximis, 0.6 mm latis; cellulis maximis, utroque latere venae in seriebus 2 ad 3 instructis, parietibus tenuibus, nodoso-crenulatis, interaneis fuscis ad parietes appressis; involucro cupuliforme, anguste alato, truncato.

NEW GUINEA, Doormankop, *Lam 1559*, altitude 1,420 m; *Lam 1721*, altitude 3,200 m.

A relative of *T. flavo-fuscum*, distinguished by stout caudex, congested stipes, and copious dark bristles. I have not located publication of this species, and have described it from specimens in the Singapore herbarium, as there named.

110. TRICHOMANES MEIFOLIUM Bory.

T. meifolium BORY ex Willdenow Sp. Pl. 5 (1810) 509; KAULFUSS, Enum. 265, pl. 2.

T. ericoides HEDWIG (1805) nomen nudum.

T. longisetum BORY in Willd. Sp. Plant. 5: 510; VAN DEN BOSCH, Hymen. Javan. 28, pl. 21.

T. foeniculaceum HOOKER, Sp. Fil. 1: 135, non Bory.
T. Pluma HOOKER, Ic. Plant. pl. 997.
T. gemmatum J. SMITH: Baker, Syn. Fil. 87, in part.

T. frondibus triplicato-pinnatis, pinnis horizontaliter patentibus rigidis, pinnulis tereti-capillaceis dichotomis incurvatis, rachi setosa, receptaculis filiformibus indusio parum longioribus. W.

T. fronde lineari-lanceolata pinnata, pinnis decompositis capillaribus subteretibus, laciniis imbricatis *Bory in litt.*

Bärwurzelblättriger Becherfarrn. W.

Habitat in sylvis montium insulae Borboniae. (*v. s.*)

Stipes *quadri- vel quinquepollicaris teres canaliculatus glaber superne setis aliquot raris obsitus.* Frons *quinquepollicaris triplicato-pinnata atrovirens, exacte facie Aethusae Mei.* Pinnae *primariae octolineares rigidae horizontaliter patentes; secundariae capillaceae trilineares teretes.* Pinnulae *dichotomae capillaceae teretes apicibus inflexis.* Indusia *cyathiformia basi attenuata pedicellata pinnulis inserta.* Receptaculum *indusio parum longius filiforme.* Rachis *universalis setis subulatis patentibus obsita, partialis hinc inde punctis prominentibus exasperata. Dignoscitur facile tenuitate et rigiditate frondis. W.*—Willdenow, loc. cit.

Although better described than were most species in its time, *T. meifolium* has been ill understood and appreciated, partly because described under another name, *T. longisetum,* at the same time, partly because of the use of a prior nomen nudum, *T. ericoides,* partly because of Hooker's reference to it of *T. foeniculaceum* Bory and *T. bauerianum* Endl., and finally and worst because of its effective supplanting by *T. Pluma.* Without seeing a really authentic specimen, I construe it confidently by Kaulfuss's illustration, and the identification with *T. meifolium* by Kuhn, Fil. Afric. 34, who had at hand the types, of *T. longisetum,* described and figured by van den Bosch in Hymen. Javanicae. Before we stood on our own feet in dealing with Philippine ferns, we had this species with identifications by European specialists, as *T. meifolium, T. foeniculaceum, T. gemmatum,* and *T. Pluma,* and in turn distributed it under all of these names; and it is only very recently that I have come to the conclusion that *T. Pluma,* which some of our specimens certainly represent, is only a luxuriant form, likely to develop wherever the slightly more lax typical form appears.

The value of the nature of the rhizome, creeping or scandent in most of the sections of the genus, more or less erect and with fascicled stipes in others, is obscured in this species by its irregularity. It is in all cases really creeping; but is not rarely so short that any difference between approximate and fascicled stipes is easily overlooked. On a single rhizome, I have found numerous stout stipes spaced 2 to 3 mm apart—and thus, since

the rhizome was there contorted, densely tufted,—and in another long and straight part, 3.5 cm apart. They are more commonly remote enough to relieve the fronds from mutual competition; also the fact that the form with long rhizomes makes pretty specimens may not escape the collector. The stipes are approximate on "typical" *T. meifolium* and *T. Pluma*. The rhizome is 1 to 2.5 mm in diameter.

The fronds are never plane. They vary greatly in this respect, but some twisting and/or bending of the minor axes, so that their divisions are directed well out of the general plane of the frond, is never absent. There is wide diversity also in the closeness of the branching, and therefore in the number of pinnules and segments, and therefore in the density of the frond; a mounted frond may leave visible a large part, or almost none, of the underlying paper.

The segments are always fairly termed setaceous; but this may mean that the axes bear no wing, which is not unusual, or that the wing is inconspicuous. Kaulfuss depicted one row of laminar cells; van den Bosch, one or two. The range from none to two can be found on single fronds. On a number of specimens, I find some segments with a lamina up to four cells wide, conspicuous to the naked eye, on otherwise normal fronds—superfluous evidence of an ancestry with better developed lamina. A wing like that on the segments is borne on all axes of the frond, even the main rachis, and most of the setæ spring from it. Even if the wing be obsolete on the segments, it is present on the rachis.

The laminar cells may be isodiametric, or somewhat elongate along the axis of the segment. Their walls are uniformly thin, straight or curved but never wavy. The brown content is closely applied to the lateral, but not normally to the marginal walls.

The sori are borne on short basal segments, on either side of the axes of the pinnules. The short pedicel is winged if other segments are, and the wing is sometimes evident part way up the involucre—or rarely all the way. The involucre is small, elongate-obconic, or with parallel sides in the upper part, opaque, perfectly truncate or rarely slightly dilated at the top.

(Madagascar). Réunion (Bourbon), *de l'Isle 102, 358*, in the United States National Herbarium. Throughout the Malay region, common in the mossy forest, on trunks and terrestrial, north to central Luzon. Amboina, *Robinson 1966*. Papua, *Schlechter 18687, 19623*, as *T. Pluma* (I cannot distinguish the

var. *alatum*). New Caledonia, *Cribs 1334*. New Hebrides, *Kajewski 867*. Samoa. Some Samoan specimens (*Vaupel, Powell, Whitmee*) show a trace of reticulation on some walls; another collection (*Reinecke 188*, in United States National Herbarium) has uniformly thin walls, but more the aspect of *T. gemmatum*. A Queensland collection, *Waller s. n.* ex Nat. Herb. N. S. W., distributed as *T. parviflorum*, may be suspected of being *T. setilobum* F. v. M., nomen, and is probably specifically distinct; it has uniformly thin walls, but the pinnules are incompletely dissected into setiform segments.

The varieties *linearis* and *contracta* of Brause, Bot. Jahrb. 56 (1920) 39, are unknown to me, but appear to be forms rather than varieties. The fronds vary everywhere from linear to lanceolate, and very stunted ones are commonly relatively broad, and congested. They may be less than 5 cm long on dwarfed old plants, and bear some sori.

Trichomanes Schultzei Brause, Bot. Jahrb. 49 (1912) 8, said to be a relative of *T. strictum*, seems from the description to be more like a lax form or relative of *T. meifolium*.

111. TRICHOMANES SCHLECHTERI Brause. Plate 60.

Trichomanes Schlechteri BRAUSE, Bot. Jahrb. 49 (1912) 10.

Eutrichomanes. Rhizoma erectum, crassum, pilis rufo-brunneis dense vestitum. Petioli fasciculati, validi, brunnei, 3,5–6 cm longi, 1,2–1,8 mm crassi, teretes, striati, pilis articulatis rubiginosis, usque ad 8 mm longis, tortis muniti. Laminae ambitu lineari-lanceolatae, usque ad 36 cm longae, cr. 3,5 cm latae, ad basin versus decrescentes, in apicem obtusiusculum desinentes, subquadripinnatifidae, olivaceae, pellucidae, glabrescentes; pinnis plus minusve 40-jugis, ambitu deltoideis, suboppositis, usque ad costam angustissime alatam partitis, subtripinnatifidis, patentibus, petiolulatis, medianis maximis 2–2,5 cm longis, basi cr. 1,8 cm latis; segmentis primariis bipinnatifidis, pinnatifidis vel linearibus, cr. 9–jugis, imbricatis, ala angusta continuis; segmentis secundariis pinnatifidis vel furcatis; laciniis numerosis, vix 0,3 mm latis, usque ad 0,8 cm longis, margine integris; rachibus costisque validis, pilis iis petioli similibus dense instructis, costis anguste alatis. Sori segmentis secundariis infimis anticis impositi, uniseriales in utroque costae latere; indusio basi anguste marginato, cupuliformi, orificio parum angustato; receptaculo longissime exserto.

* * * * * * *

Nordöstl. Neu-Guinea: Kaiser-Wilhelmsland, auf Bäumen in den Wäldern des Dischore, ca. 1200 m ü. M. (Schlechter n. 19612.—29. Mai 1909).

Gehört in den Formenkreis von *T. longisetum* Bory. . . . bei *T. longisetum* ist der Blattstiel länger und kahl, die Blattfläche mehr dreieckig. . . .—Brause, loc. cit.

An exceptionally well-marked species, with densely bristly axes, the dark-chestnut setæ on the stipe reaching a length of 3

mm; fronds long and linear, the lower pinnæ gradually much reduced and hardly imbricate; the pinnæ and their divisions in the middle and upper part of the frond the most densely imbricate in the genus. The brown lamina is three or four cells wide; the cells elongate obliquely to the costa; marginal walls thin, all other lateral walls thick, inconspicuously and irregularly pitted, and in places no pits visible.

Besides a cotype, I have in hand, from the Singapore and Bureau of Science herbaria, an unnumbered collection by Boden Kloss (as *T. ericoides*), from M. Carstensz, Dutch New Guinea, Camp VIb.

112. TRICHOMANES GEMMATUM J. Smith. Plate 61, fig. 2.

Trichomanes gemmatum J. SMITH in Hooker's Journ. Bot. 3 (1841) 417 (nomen); BAKER, Syn. Fil. (1867) 87.

Rhizome strong, wiry, tomentose, beset with numerous long black wiry fibres; *st.* 1–3 in. l., naked, wiry, winged above; *fr.* 2–6 in. l., 1–2 in. br., erect, subrigid, ovate-oblong, bipinnatifid; main *rachis* narrowly winged; *pinnae* erecto-patent, cut down to a narrowly-winged rachis; lower *pinnl.* deeply forked with subrigid, linear-filiform *segm.* 1½–2 lin. l., cellules large; *sori* 1 to 8 to a pinna, minute, axillary, the tube turbinate, stalked, the mouth nearly truncate.—Baker, loc. cit.

As Baker takes up the name of J. Smith, the type is the only specimen cited by Smith, *Cuming 400*, from Malacca.

Distinguished from *T. meifolium* by somewhat broader and far less numerous segments. The laminar wing is mostly only two or three cells wide, but these cells are large, so that the segments are linear rather than setaceous. The wing continues far down the stipe, but may be broken off there. The pinnæ are conspicuously broad, and therefore imbricate, but there is no conspicuous departure of pinnules or segments from the plane of the frond. The pinnules being long, their pinnate plan is evident; but this distinction from *T. meifolium* is in degree only, as in the latter species also they are pinnate, the fact being commonly obscured by wealth of fairly equal segments. The cell walls are uniformly thin, or very slightly and irregularly thickened. Rhizome creeping; stipes usually approximate.

Superficially, this is exceedingly like the Polynesian species (*T. Asae-Grayi*) which has been called *T. parviflorum*; but the latter has thicker and distinctly pitted walls and fascicled stipes. Which, if either, is true *T. parviflorum*, I do not know, and under the circumstances leave them with the names authenticated by typical specimens.

MALACCA, *Cuming 400*, cotypes in Gray Herb., U. S. Nat. Herb., Bur. Sci. herb., and herb. Copeland. MOUNT OPHIR, *Brackenridge* (as *T. foeniculaceum*); *Wight 241; Hose; Ridley; Derry 607*. PAHANG. KELANTAN. BORNEO, *Hewitt 33*. A single Philippine specimen, *Calvin 332*, from Mount Banahao, Luzon, seems to be *T. gemmatum*, but, unless it can be found to be established there, it may be an aberrant *T. meifolium*. The two seem to be quite distinct in Malacca.

Genus CARDIOMANES Presl

Costa nulla. Venae pedato-flabellatae, crebrae, furcatae, steriles ante marginem frondis apice obtuso desinentes. Sorus intramarginalis, immersus. Indusium campanulatum, ore integrum. Capsulae lenticulares, receptaculo clavato obtuso demum exserto undique affixae.—Presl, Hymenophyllaceae (1843) 104.

Construing *Trichomanes* in the broadest sense, this is the only really isolated species in the Old World, nor is there any comparatively isolated group of species. Accordingly, in an era of genus-splitting, this is the only one of the many genera carved from *Trichomanes* by Presl and his immediate successors clearly enough definable to make its maintenance expedient.

Rhizome stout, creeping, terrestrial; stipes rigidly erect; frond reniform, coriaceous, several cells in thickness; venation flabellate-dichotomous; sori contiguous around the outer border, receptacle cylindrical. A single species, native of New Zealand.

CARDIOMANES RENIFORME (Forster) Presl.

C. reniforme (Forster) PRESL, Hymen. (1843) 105.
Trichomanes reniforme FORSTER, Prodromus (1786) 84; SCHKUHR, Kryptog. Gewächse 130, pl. 134; HOOKER and GREVILLE, Ic., pl. 31.

Frondibus simplicibus reniformibus stipitatis multifloris, receptaculis seminum exsertis cylindricis. F.
Nova Zeelandia.—Forster, loc. cit.

The characters are those of the genus. The fronds reach a diameter of 8 cm or more. Although it has never become common, this fern has long been in cultivation. Herbarium specimens purporting to be from Hawaii and Fiji may have escaped from gardens.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Trichomanes pyxidiferum.* Natal, *Wood; Herb. Univ. Calif. 393318,* sorus, × 15.
2. *Trichomanes stenosiphon.* Type, sorus, × 15.
3. *Trichomanes parvum.* Type, sorus, × 15.
4. *Trichomanes draytonianum.* Type, tip of segment, × 150.
5. The same specimen, sorus, × 15.
6. The same specimen, margin of lip, × 150.
7. The same specimen, margin of frond, × 330.

PLATE 2

FIG. 1. *Trichomanes schmidianum.* Cotype (?), in Gray Herb., sorus, × 15.
2. *Trichomanes Hosei.* Cotype, in Herb. Singapore, frond, × 1.
3. The same specimen, detail of cellular structure, × 400.
4. The same specimen, sorus, × 15.

PLATE 3

FIG. 1. *Trichomanes Colensoi. Herb. Univ. Calif. 393321,* frond, × 1.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.

PLATE 4

FIG. 1. *Trichomanes latifrons.* A Luzon specimen, *For. Bur. 16318,* frond, × 1.
2. The same specimen, sorus, × 15.
3. The same specimen, detail of structure, × 400.
4. The same species, primary segment of cotype (?), in Gray Herb., × 5.
5. Gray Herb. specimen, sorus, drawn wet, × 15.

PLATE 5

FIG. 1. *Trichomanes parvulum.* Tahiti specimen, *Grant 5282,* × 2.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.

FIGS. 4 and 5. Yunnan specimens, *Hancock 136,* in U. S. Nat. Herb., laminæ, × 2.

PLATE 6

FIG. 1. *Trichomanes Teysmannii. Raciborski 626,* in Herb. Bur. Sci., frond, × 1.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.

FIGS. 4 and 5. *Trichomanes alagense.* Cotype, fronds, × 2.

FIG. 6. The same specimen, detail of structure, × 400.
7. The same specimen, sorus, × 15.

PLATE 7

FIG. 1. *Trichomanes nitidulum.* From Java, *Copeland.*
2. *Trichomanes Francii.* Cotype.
3. *Trichomanes digitatum.* From Mauritius.
4. *Trichomanes digitatum.* From Luzon, *Robinson.*
5. *Trichomanes dichotomum.* From Java, *Raciborski.*
6. *Trichomanes palmatifidum.* From Sumatra, *Winkler 111.*
7. *Trichomanes Lyallii.* From New Zealand, *Ranft.*

PLATE 8

FIGS. 1 and 2. *Trichomanes sibthorpioides. Hillebrand* in Madagascar, in Herb. Copeland, fronds, × 4.
3. The same specimen, detail of structure, × 400.
4. The same specimen, sorus, × 15.
5. The same specimen, sorus with one dichotomous lip.

PLATE 9

FIG. 1. *Trichomanes vitiense. Bauerlein* in New South Wales, fertile frond, × 5.
2. The same specimen, detail of structure, × 330.
3. *Trichomanes liberiense.* Type, sterile frond, × 10.
4. The same specimen, fertile frond, × 10.
5. The same specimen, detail of structure, × 400.
6. The same specimen, sorus, × 15.

PLATE 10

FIG. 1. *Trichomanes taeniatum.* Type, frond, scale shown.
2. The same specimen, frond, × 2.
3. The same specimen, sorus, × 15.
4. The same species, *Grant 4401*, sorus.

PLATE 11

FIG. 1. *Trichomanes palmatifidum. Herb. Univ. Calif. 391828*, sorus, × 25.
2. *Trichomanes Ridleyi.* Type, frond, × 2½.
3. The same specimen, sorus, × 25.
4. *Trichomanes Lyallii. U. S. Nat. Herb. 817020*, sorus, × 25.

PLATE 12

FIG. 1. *Trichomanes humile.* Tahiti specimen, *Setchell and Parks 214*, detail of structure, × 75.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. *Trichomanes filiculoides. Lauterbach 541*, frond, × 2.
5. The same specimen, detail of structure, × 400.
6. The same specimen, sorus, × 15.

PLATE 13

FIG. 1. *Trichomanes gracillimum.* Type, frond, × 2.
2. The same specimen, detail of structure, × 400.
3. *Trichomanes gracillium.* Mount Masingit specimen, *Bur. Sci. 37576*, frond, × 2.
4. The same specimen, detail of structure, × 400.

PLATE 14

FIG. 1. *Trichomanes endlicherianum.* Norfolk Island specimen, *Herb. Copeland 2312*, frond, × 1.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. *Trichomanes tenue.* Cotype, in Gray Herb. sorus, × 15.
5. The same specimen, detail of structure, × 400.
6. The same specimen, × 75.

PLATE 15

FIG. 1. *Trichomanes endlicherianum.* Cotype of *T. erectum*, in Gray Herb., frond, × 1.
2. The same specimen, detail of structure, × 75.
3. The same specimen, detail of structure, × 400.
4. The same specimen, sorus, × 15.
5. *Trichomanes Naumannii.* Cotype, *U. S. Nat. Herb. 340498*, frond, × 2.
6. The same specimen, detail of structure, × 400.
7. The same specimen, sorus, × 15.

PLATE 16

FIG. 1. *Trichomanes Werneri. Schlechter 17304* (*Herb. Univ. Calif. 391768* in part), frond, × 2.
FIGS. 2 to 4. The same specimen, detail of structure, × 75 and 400.
5 and 6. The same specimen, sorus, × 15.

PLATE 17

FIGS. 1 to 3. *Trichomanes Vieillardii. Franc 830* (*Herb. Copeland 10914*), fronds, × 2.
FIG. 4. The same specimen, detail of structure, × 400.
5. The same specimen, sorus, × 15.
6. The same species. *Rosenstock, Fil. Nov. Caled. 135*, in Herb. Bur. Sci., frond, × 2.
7. The same specimen, detail of structure, × 400.
8. The same specimen, sorus, × 15.

PLATE 18

FIG. 1. *Trichomanes bipunctatum.* From Mauritius, *U. S. Nat. Herb. 593140*, detail of structure, × 75.
2. The same specimen, × 400.
3. The same specimen, sorus and venulation, × 15.
4. The same species. Fiji specimen, *Parks 20633*, detail of structure, × 75.
5. *Trichomanes bilabiatum. Palmer and Bryant 315*, venulation, × 75.
6. The same specimen, sorus, × 15.

PLATE 19

FIG. 1. *Trichomanes latemarginale.* Type collection, × 4.
2. *Trichomanes rupicolum.* Type collection, × 4.
3. *Trichomanes pervenulosum.* Type collection, × 4.
4. *Trichomanes Nymani. Schlechter 18610*, × 4.

PLATE 20

FIG. 1. *Trichomanes brevipes. Cuming 2*, probably the cotype of *T. brevipes*, in Gray Herb., venulation, × 75.
2. The same specimen, sorus, × 15.
3. *Cuming 316*. Cotype of *T. melanorhizon*, in Gray Herb., venulation, × 75.
4. The same specimen, sorus, × 75.
5. *Cuming 150*. Substantial cotype of *Crepidomanes*, in Gray Herb., venulation, × 75.
6. The same specimen, sorus, × 15.
7. Cotype of *Trichomanes anomalum*, in U. S. Nat. Herb., sorus, × 15.

PLATE 21

FIG. 1. *Trichomanes Christii*. Type, in Herb. Bur. Sci. frond, × 1.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. The same species, *Bur. Sci. 41743*, venulation, × 75.
5. The same species, sorus, × 15.

PLATE 22

FIG. 1. *Trichomanes venulosum. Schlechter 16370* (*Herb. Univ. Calif. 227254*), venulation, × 75.
2. The same specimen, sorus, × 15.
3. *Trichomanes pervenulosum*. Cotype, in Herb. Bur. Sci., fertile fronds, × 5.
4. The same specimen, venulation, × 70.

PLATE 23

FIG. 1. *Trichomanes intramarginale. C. P. 3361*, in Gray Herb., frond, × 2.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. *Trichomanes megistostomum*. Type, lamina, × 2.5.
5. The same specimen, sorus, nearly dry, × 15.
6. The same specimen, sorus, wet.

PLATE 24

FIG. 1. *Trichomanes latemarginale*. Probable type, *U. S. Nat. Herb. 51149*, venulation, × 75.
2. The same specimen, sorus, × 15.
3. The same species, ex Herb. Hongkong, *Herb. Copeland 2314*, frond, × 5.
4. The same specimen, venulation, × 75.
5. The same specimen, detail of structure, × 400.
6. The same specimen, sorus, × 15.

PLATE 25

FIG. 1. *Griffith 151*, in Gray Herb. ex Herb. Kew, possible cotype of *D. plicatum*, segment, showing venulation, × 75.
2. The same specimen, sorus, × 15.

FIG. 3. *Trichomanes insigne.* *G. Mann, U. S. Nat. Herb. 329769,* sorus, × 15.
4. *Rosenstock, Fil. Chinenses 42,* from Pinfa, sorus and venulation, × 15.
5. *G. Mann, Herb. Univ. Calif. 330969,* from Cachor, venulation, × 75.
6. The same specimen, sorus, × 15.

PLATE 26

FIG. 1. *Hooker and Thomson, Herb. Univ. Calif. 267642,* venulation, × 75.
2. The same specimen, sorus, × 15.
3. *G. Mann, Herb. Univ. Calif. 267023,* venulation, × 75.
4. The same specimen, sorus, × 15.
5. *G. Mann,* Jainta Hills, *U. S. Nat. Herb. 329770,* frond, × 1.
6. The same specimen, venulation, × 75.
7. The same specimen, sorus, × 15.

PLATE 27

FIG. 1. *Trichomanes Makinoi.* Topotype or cotype, ex Herb. Hongkong, frond, × 3.
2. The same specimen, sorus, × 25.

PLATE 28

FIG. 1. *Trichomanes sublimbatum.* Rosenstock, *Fil. Jav. Orient. 67* in Herb. Copeland, frond, × 3.
2. The same specimen, detail of structure, × 400.
3. *Trichomanes henzaianum.* Cotype (?), in Gray Herb., frond, × 5.
4. The same specimen, venulation, × 60.

PLATE 29

FIG. 1. *Trichomanes beccarianum.* Type fragment, × 5.
FIGS. 2 to 7. Mindanao specimens, *Clemens,* in Herb. Copeland, fronds, × 5.
FIG. 8. The same collection, venulation, × 60.
9. Cotype of *Trichomanes minutissimum,* in Herb. Bur. Sci., frond, × 10.
10. The same specimen, sorus, × 15.
11. The same specimen, detail of structure, × 400.

PLATE 30

FIGS. 1 and 2. *Trichomanes Motleyi.* Cotype, in Gray Herb., fronds, × 5.
FIG. 3. The same collection, detail of structure, × 60.
4. The same collection, sorus, × 5.
FIGS. 5 and 6. *Trichomanes cultratum.* Cotype, in Gray Herb., fronds, × 5.
FIG. 7. The same collection, venulation, × 60.

PLATE 31

FIGS. 1 to 4. *Trichomanes omphalodes.* Cotype, in Gray Herb., fronds, × 5.

FIG. 5. The same collection, structure, × 60.
6. The same collection, sori, in end-view, × 5.
7. *Trichomanes montanum, U. S. Nat. Herb. 817008*, frond, × 2.5.
8. The same specimen, sorus, × 15.

PLATE 32

FIG. 1. *Trichomanes exiguum. Beckett*, in Gray Herb., frond, × 5.
2. The same specimen, structure, × 60.
FIGS. 3 and 4. *Trichomanes Wallii.* Ex Herb. Wm. Ferguson, in Gray Herb., fronds, × 5.
FIG. 5. The same collection, structure, × 60.
6. *Trichomanes cuspidatum. U. S. Nat. Herb. 593139*, frond, × 3.
7. The same specimen, sorus, × 15.

PLATE 33

FIG. 1. *Trichomanes bimarginatum.* Cotype, *C. P. 2986*, in Gray Herb., frond, × 5.
2. The same species. Samoa specimen, *Powell*, in Gray Herb., frond, × 5.
3. Fiji specimen, *Brackenridge*, in U. S. Nat. Herb., venulation, × 60.
4. The same specimen, sori, × 5.
FIGS. 5 and 6. *Trichomanes craspedoneuron.* Type, *U. S. Nat. Herb. 593183*, fronds, × 5.
FIG. 7. The same collection, detail of structure, × 400.
8. The same collection, sorus, × 15.

PLATE 34

FIG. 1. *Trichomanes mindorense.* Cotype, in Herb. Bur. Sci., fronds, × 5.
2. The same specimen, detail of structure, × 60.
FIGS. 3 and 4. *Trichomanes erosum. O. F. Cook 506* (*U. S. Nat. Herb. 946426*), fronds, × 5.
FIG. 5. The same collection, detail of structure, × 400.
6. The same collection, sorus, × 15.

PLATE 35

FIG. 1. *Trichomanes radicans* (*T. japonicum*). *Stanford, U. S. Nat. Herb. 291511*, detail of structure, × 400.
2. The same specimen, sorus, × 15.
3. *Trichomanes cyrtotheca. Hillebrand, Herb. Univ. Calif. 393318*, pinna, × 5.
4. The same specimen, sorus, × 15.

PLATE 36

FIG. 1. *Trichomanes davallioides.* Specimen collected by Gaudichaud, in Herb. Bur. Sci., plant, scale indicated.
2. The same specimen, sorus, × 15.

PLATE 37

Trichomanes cyrtotheca. Specimen collected by Hillebrand, ex Herb. Berlin.

PLATE 38

FIG. 1. *Trichomanes maximum. Herb. Bogor. 108874*, part of pinna, × 5.
2. The same specimen, detail of structure, × 160.
3. The same specimen, sorus, × 15.
4. *Trichomanes maximum.* From Tahiti, *Grant 3625* (*Herb. Univ. Calif. 437783*), tip of pinna, × 40.
5. *Trichomanes aphlebioides. King, Herb. Copeland 12814*, small pinna, × 5.
6. The same specimen, tip of pinna, × 40.
7. The same specimen, detail of structure, × 160.
8. *Trichomanes aphlebioides.* Cotype, in Herb. Univ. Calif., sorus, × 15.

PLATE 39

FIG. 1. *Trichomanes superbum. Foxworthy*, from Sarawak, Herb. Bur. Sci., end of pinna, × 5.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. Type fragment of *Trichomanes ignobile*, juvenile frond, × 2.
5. The same specimen, detail of structure, × 400.

PLATE 40

FIG. 1. *Trichomanes grande.* Type, in Herb. Copeland, portion of pinna, × 5.
2. The same specimen, tip of segment, × 40.
3. The same specimen, detail of structure, × 400.
4. The same specimen, sorus, × 15.
5. *Trichomanes intermedium.* Cotype, *U. S. Nat. Herb. 51161*, sorus, × 15.

PLATE 41

FIG. 1. *Trichomanes blepharistomum.* Type, portion of pinna, × 5.
2. The same specimen, tip of segment, × 40.
3. The same specimen, detail of structure, × 400.
4. The same specimen, old sorus, × 15.
5. The same species, *Bur. Sci. 79655*, young sorus, × 15.
6. The same species, a narrowly winged sorus, × 15.

PLATE 42

FIG. 1. *Trichomanes apiifolium.* Cotype, *Herb. Copeland 1965*, sorus, × 15.
2. *Trichomanes bauerianum.* Norfolk Island specimen, *Herb. Univ. Calif. 418050*, sorus, × 15.
3. *Trichomanes polyanthum.* From Huahine, *Grant 5325* (*Herb. Univ. Calif. 437786*), sorus, × 15.
4. *Trichomanes Baldwinii. Heller 2179* (*Herb. Univ. Calif. 150243*), portion of pinna, × 5.
5. The same specimen, detail of structure, × 400.
6. The same specimen, trichome, × 200.
7. The same specimen, sorus, × 15.
8. The same species, *Baldwin, Herb. Univ. Calif. 122648*, sorus, × 15.

PLATE 43

FIG. 1. *Trichomanes obscurum. Palmer and Bryant 500*, from Java (*U. S. Nat. Herb. 651944*), pinnule, × 4.
2. The same specimen, detail of structure, × 400.
3. The same specimen, sorus, × 15.
4. *Trichomanes latipinnum.* Type, in Herb. Copeland, pinnule, × 4.
5. The same specimen, detail of structure, × 400.
6. The same specimen, sorus, × 15.

PLATE 44

FIG. 1. *Trichomanes obscurum* (*T. papillatum*). *Cuming 189* (*Herb. Copeland 2032*), detail of structure, × 400.
2. The same species, *Cuming 134* (*Herb. Copeland 2035*), sorus, × 15.
3. The same species, *Foxworthy 243* (*Herb. Copeland 2156*), from Sarawak, × 5.
4. The same specimen, detail of structure, × 400.
5. The same specimen, sorus, × 15.

PLATE 45

FIG. 1. *Trichomanes dentatum.* Cotype, *Brackenridge*, Tahiti, in U. S. Nat. Herb., pinna.
2. The same specimen, pinnule.

PLATE 46

FIG. 1. *Trichomanes dentatum.* Cotype in U. S. Nat. Herb., tip of pinnule.
2. The same specimen, detail of structure, × 800.
3. The same species, New Caledonia specimen, *Vieillard*, pinnule, × 5.
4. The same specimen, detail of structure, × 800.

PLATE 47

FIG. 1. *Trichomanes elongatum. U. S. Nat. Herb. 817033*, part of pinna, × 4.
2. The same specimen, detail of structure, × 400.
3. *Trichomanes longicollum. Franc 707* (*Herb. Copeland 10874*), part of pinna, × 4.
4. The same specimen, detail of structure, × 400.
5. The same specimen, sorus, × 15.

PLATE 48

FIG. 1. *Trichomanes extravagans.* Type, with scale indicated.
2. The same specimen, pinnule, × 2.
3. The same specimen, sorus, × 15.

PLATE 49

FIG. 1. *Trichomanes cupressoides. Holst 1244* (*U. S. Nat. Herb. 807579*), plant, with scale indicated.
2. The same specimen, part of pinna, × 2.
3. The same specimen, detail of structure, × 200.

PLATE 50

Trichomanes batrachoglossum. Type, in U. S. Nat. Herb., scale indicated.

PLATE 51

FIG. 1. *Trichomanes batrachoglossum.* Type, part of pinna, × 4.
2. The same specimen, detail of structure, × 400.
3. *Trichomanes stylosum. Ayres,* in Mauritius, *U. S. Nat. Herb. 51119,* pinna, × 3.
4. The same specimen, detail of structure, × 400.
5. The same specimen, sorus, × 15.

PLATE 52

FIG. 1. *Trichomanes javanicum.*
2. *Trichomanes asplenioides.*
3. *Trichomanes atrovirens.*
4. *Trichomanes boryanum.*
5. *Trichomanes singaporianum.*

PLATE 53

FIG. 1. *Trichomanes densinervium.* Type.
2. *Trichomanes Kingii.* Type.
3. *Trichomanes acrosorum.* Type.
4. *Trichomanes sumatranum.*

PLATE 54

Trichomanes crassum. Type, in Herb. Bur. Sci., scale indicated.

PLATE 55

FIG. 1. *Trichomanes asplenioides. Bur. Sci. 1581 Weber,* detail of structure, × 400.
2. *Trichomanes atrovirens. Copeland 206,* detail of structure, × 400.
3. *Trichomanes crassum.* Type, detail of structure, × 400.

PLATE 56

FIG. 1. *Trichomanes Cumingii.* Cotype, *Herb. Copeland, 2240,* part of pinna.
2. The same specimen, detail of structure.
3. *Trichomanes strictum. Herb. Univ. Calif. 398322,* detail of structure, × 400.
4. The same specimen, sorus, × 15.

PLATE 57

FIG. 1. *Trichomanes setaceum.* Cotype of *T. Merrillii,* in Herb. Copeland, detail of structure, × 400.
2. *Trichomanes laetum. Vieillard 2139,* in Gray Herb., detail of structure, × 400.
3. *Trichomanes caudatum.* Type, in U. S. Nat. Herb., segment, × 75.
4. The same specimen, detail of structure.
5. The same specimen, sorus.

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PLATE 58

FIG. 1. *Trichomanes caudatum.* Type, *U. S. Nat. Herb. 51176.*
2. *Trichomanes flavo-fuscum.* Cotype, in Gray Herb., scale indicated.

PLATE 59

FIG. 1. *Trichomanes compactum.* Type, in Herb. Singapore, type sheet, scale indicated.
2. The same specimen, detail of structure, × 200.
3. The same specimen, sorus, × 15.

PLATE 60

Trichomanes Schlechteri. Cotype, in Herb. Univ. Calif.

PLATE 61

FIG. 1. *Trichomanes Asae-Grayi.* Cotype, *U. S. Nat. Herb. 51163.*
2. *Trichomanes gemmatum.* Cotype, in Gray Herb.

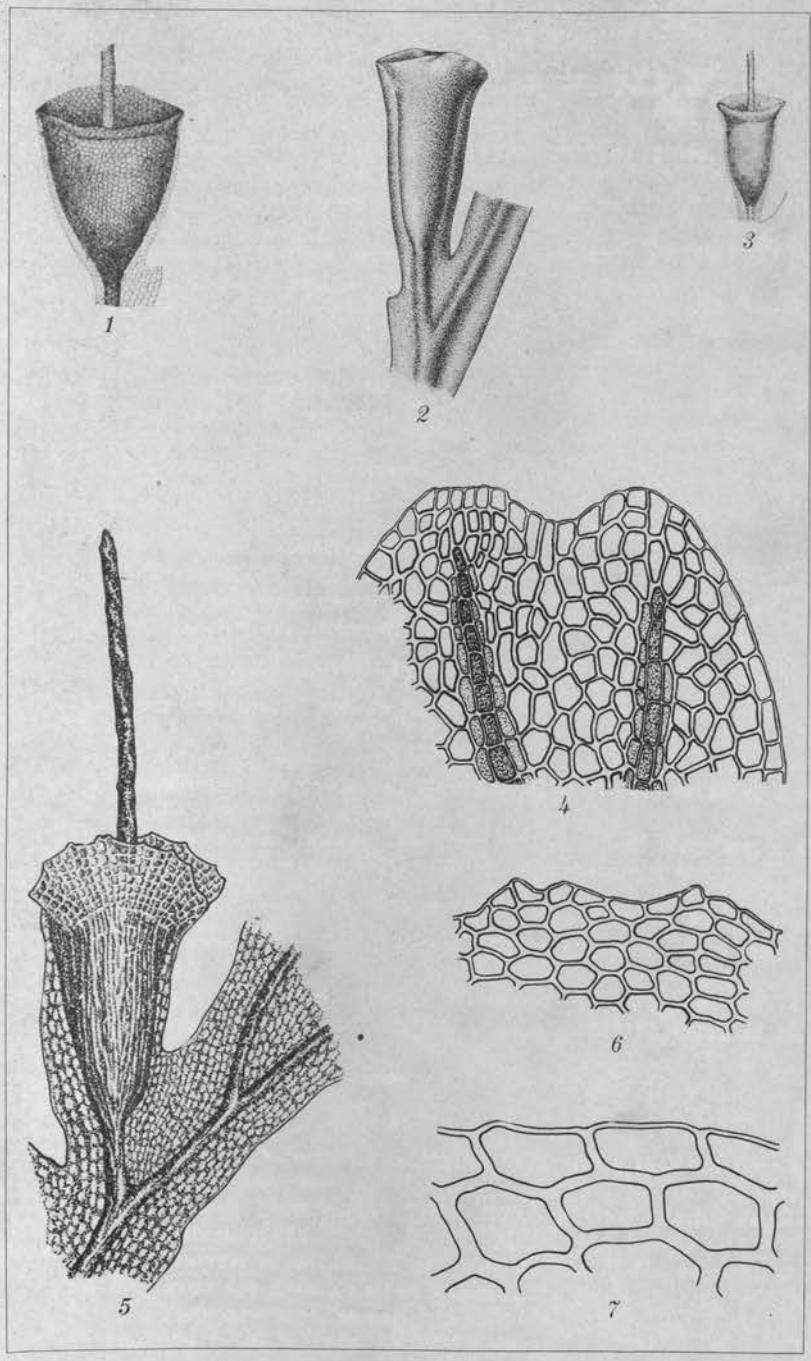
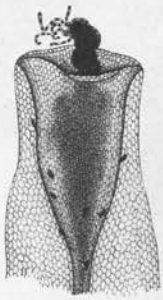


PLATE 1.



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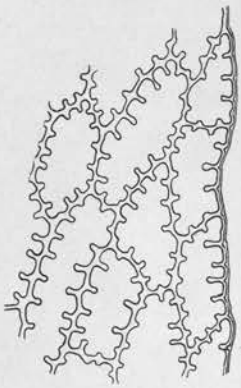


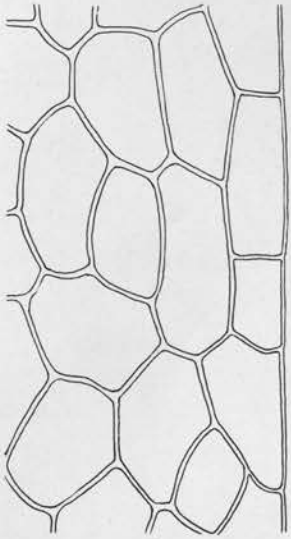
3

2

4

PLATE 2.

1



2

3

PLATE 3.

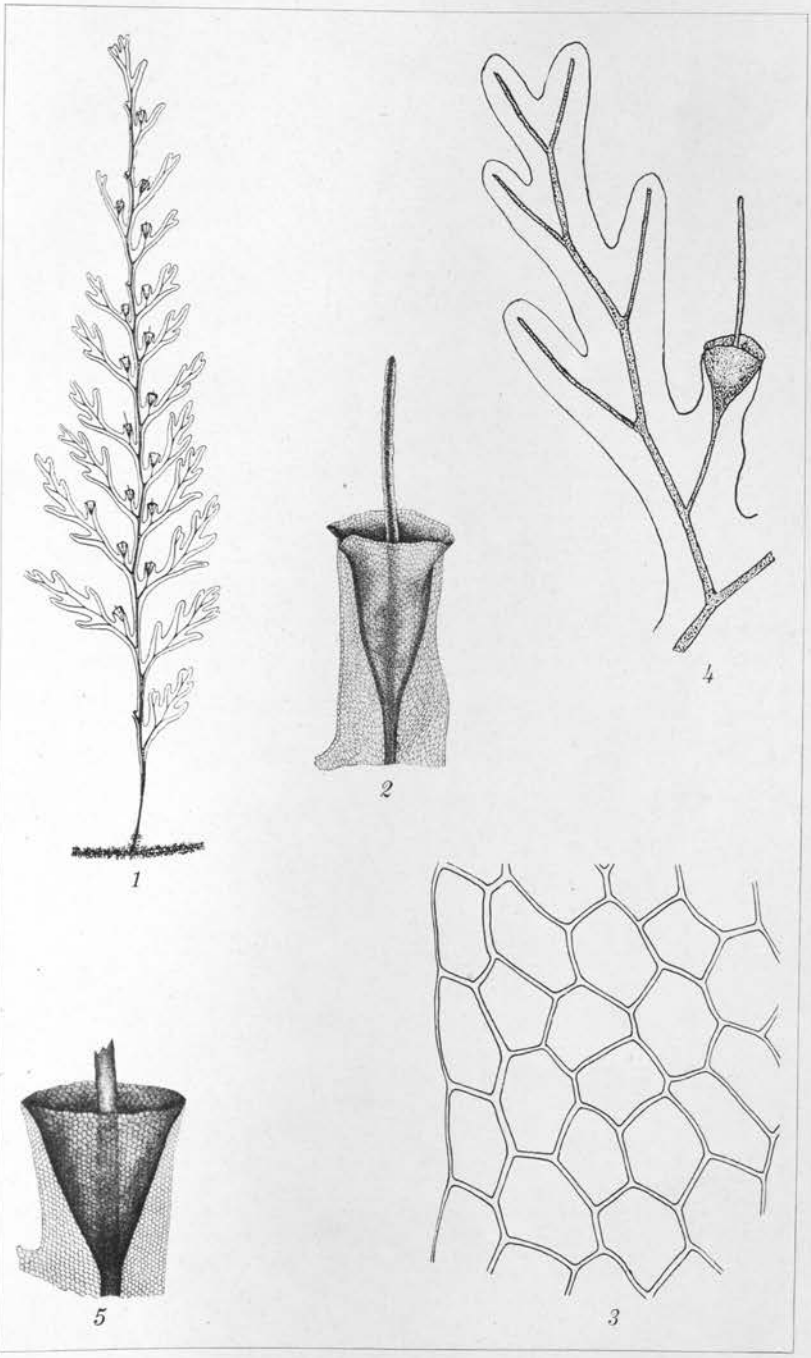


PLATE 4.

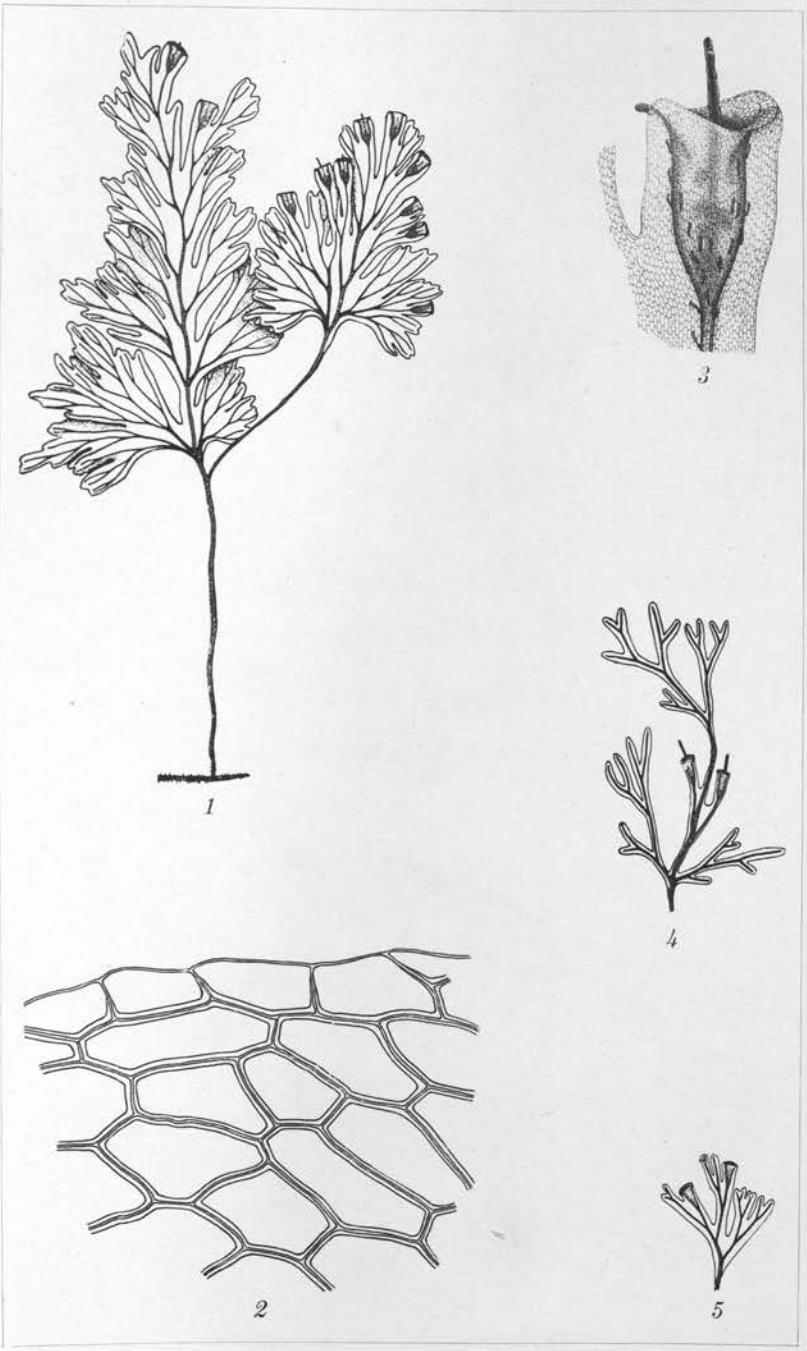


PLATE 5.

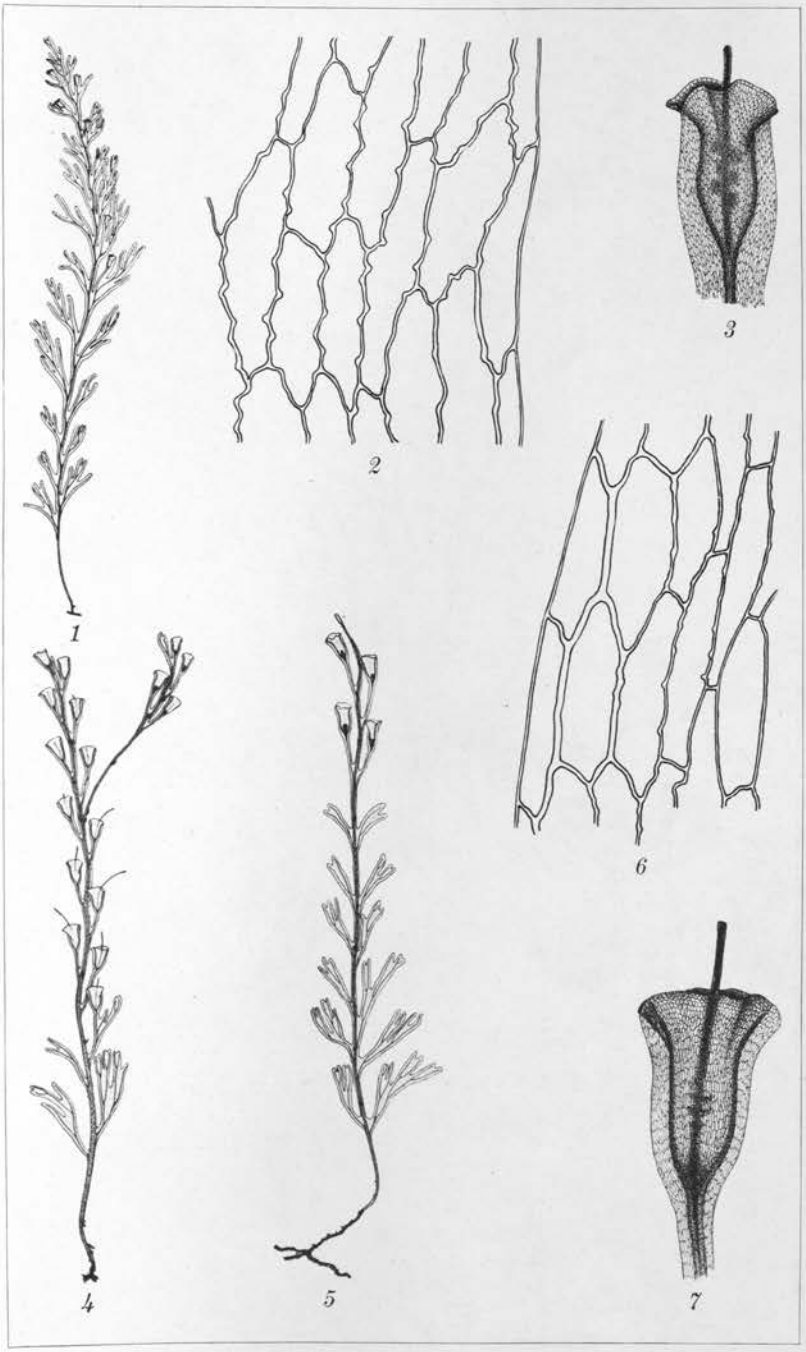


PLATE 6.

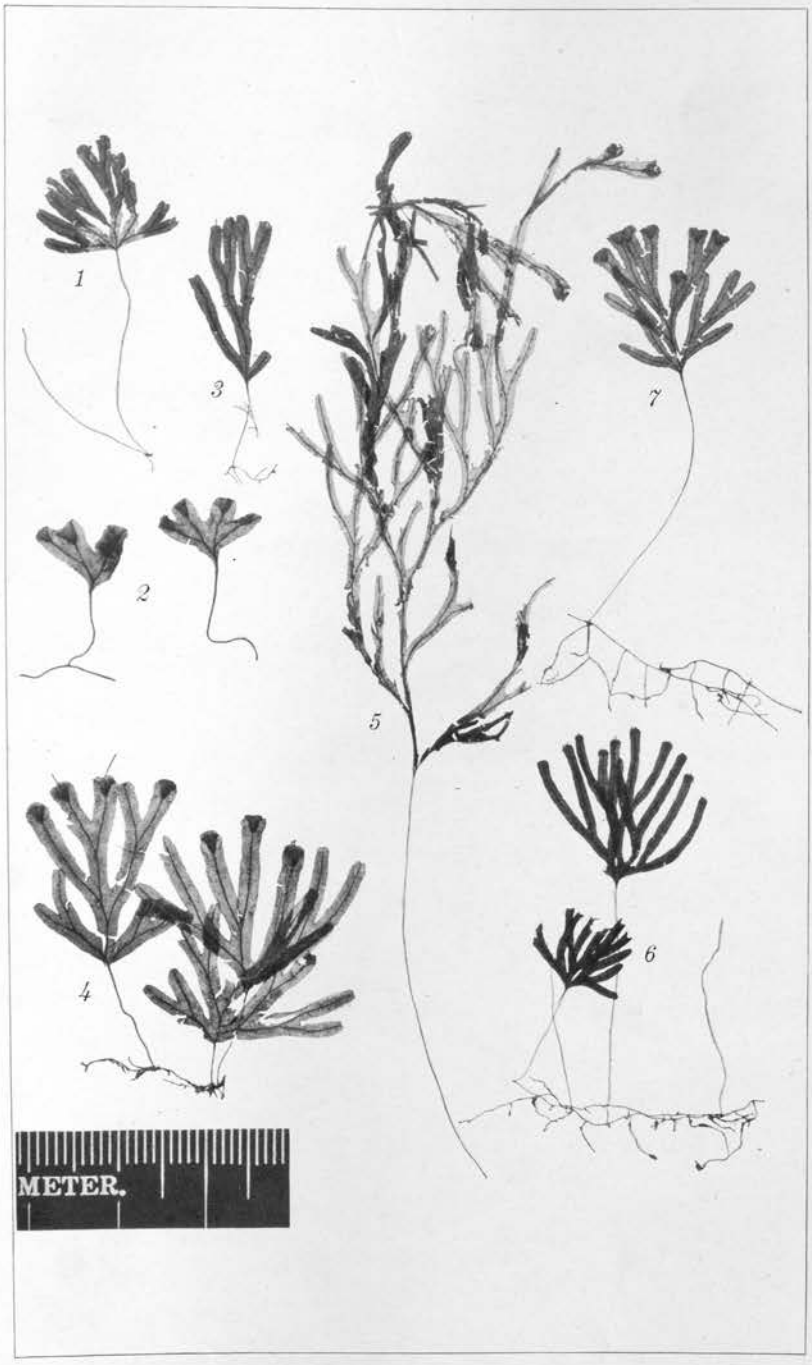
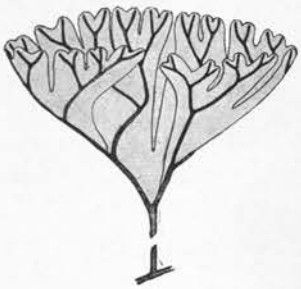


PLATE 7.



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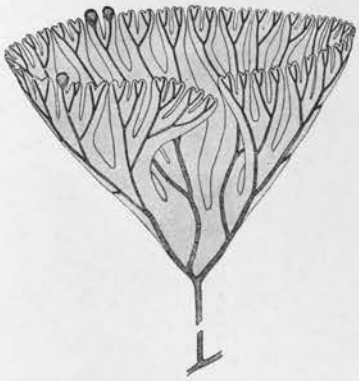

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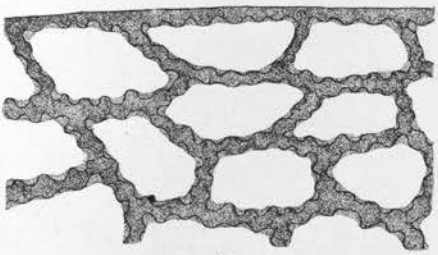

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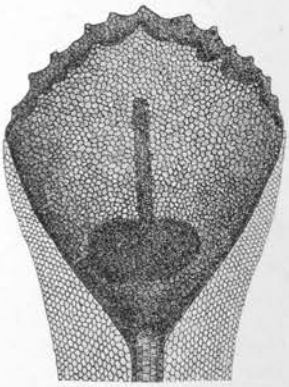

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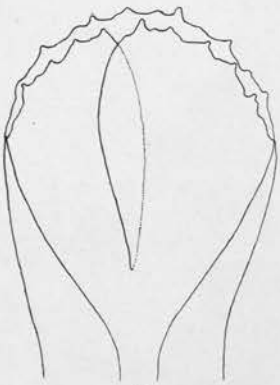

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PLATE 8.

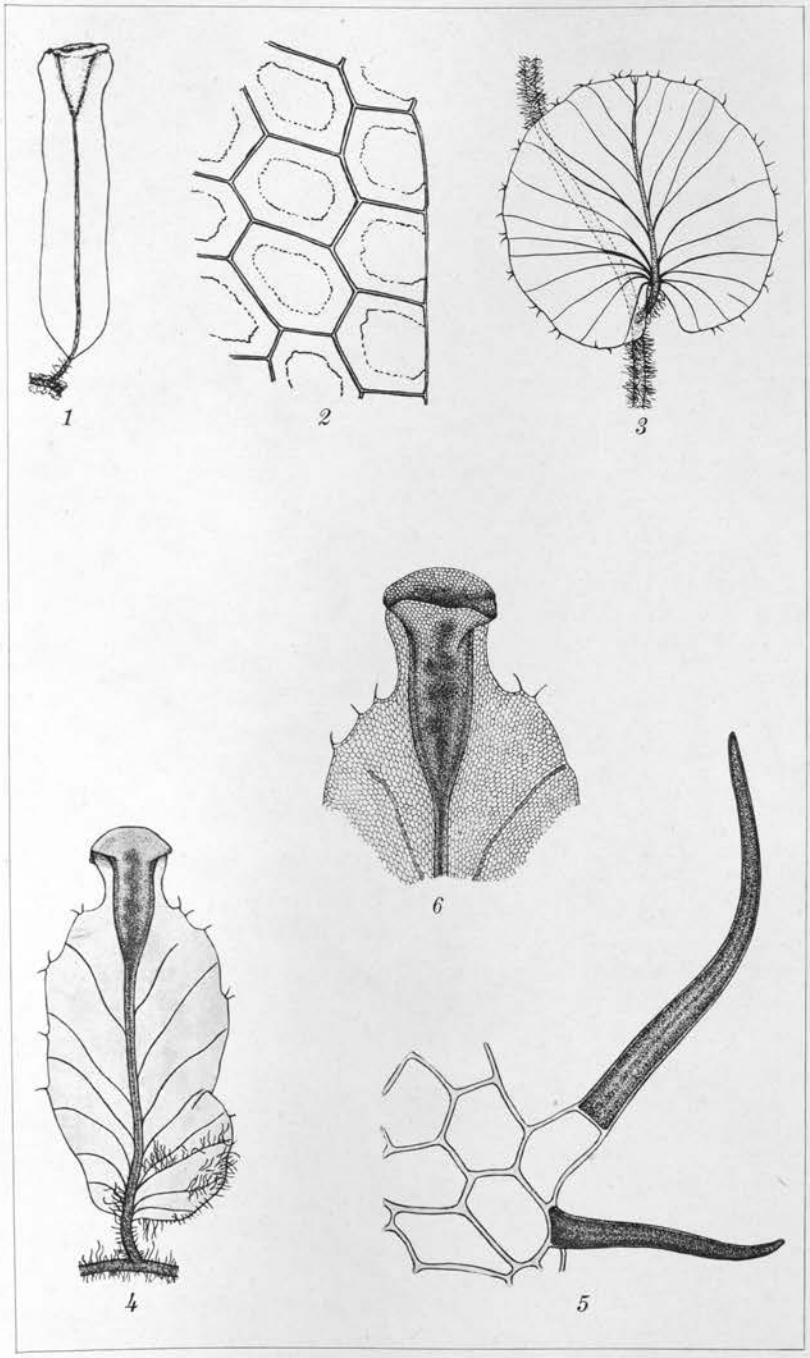


PLATE 9.

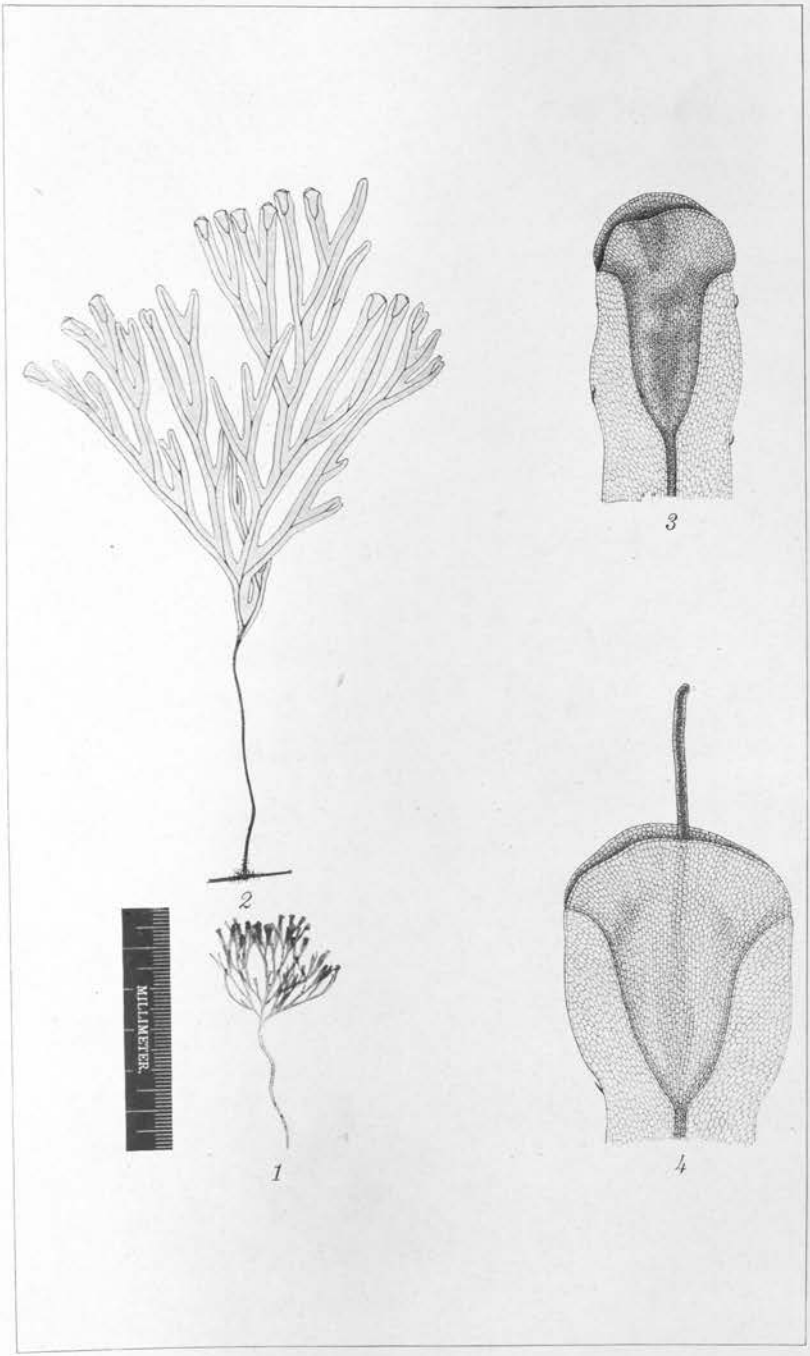


PLATE 10.

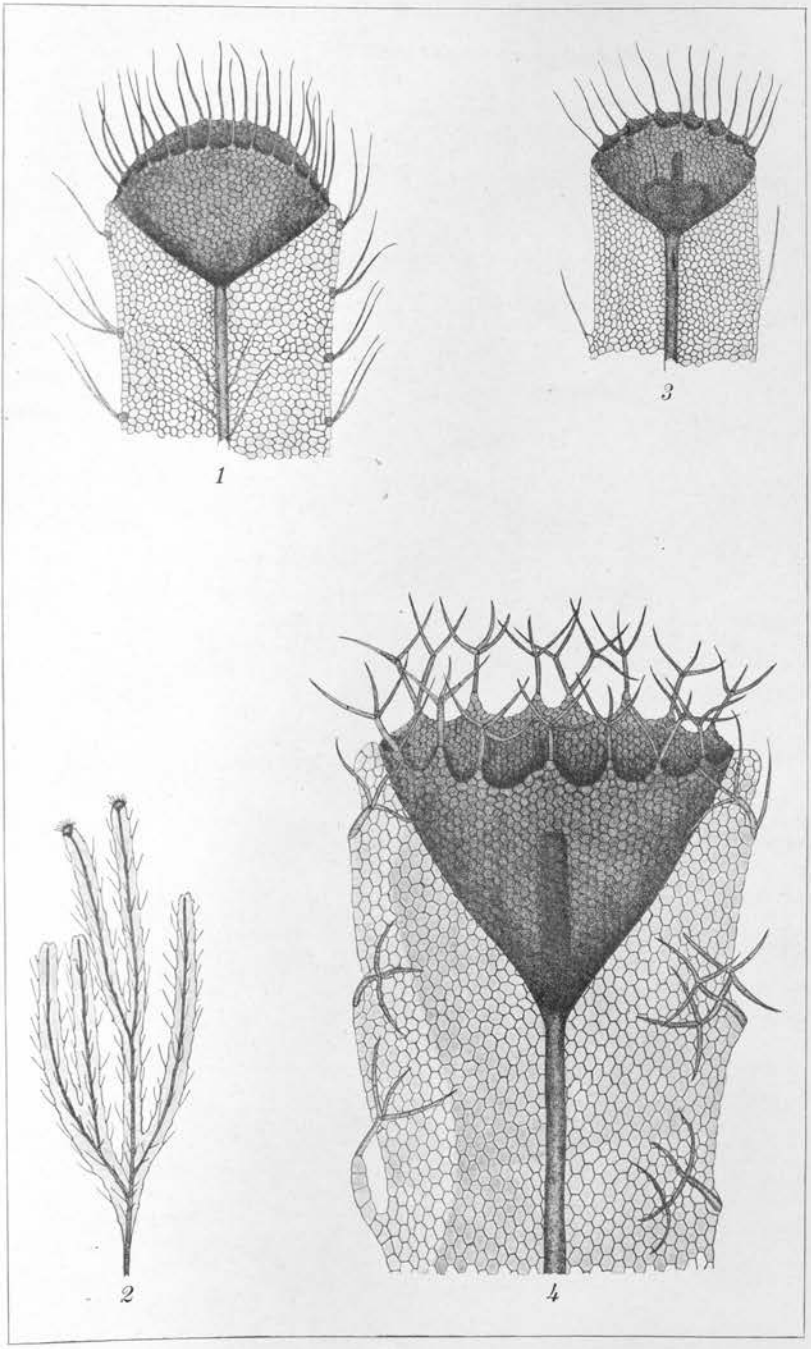


PLATE 11.

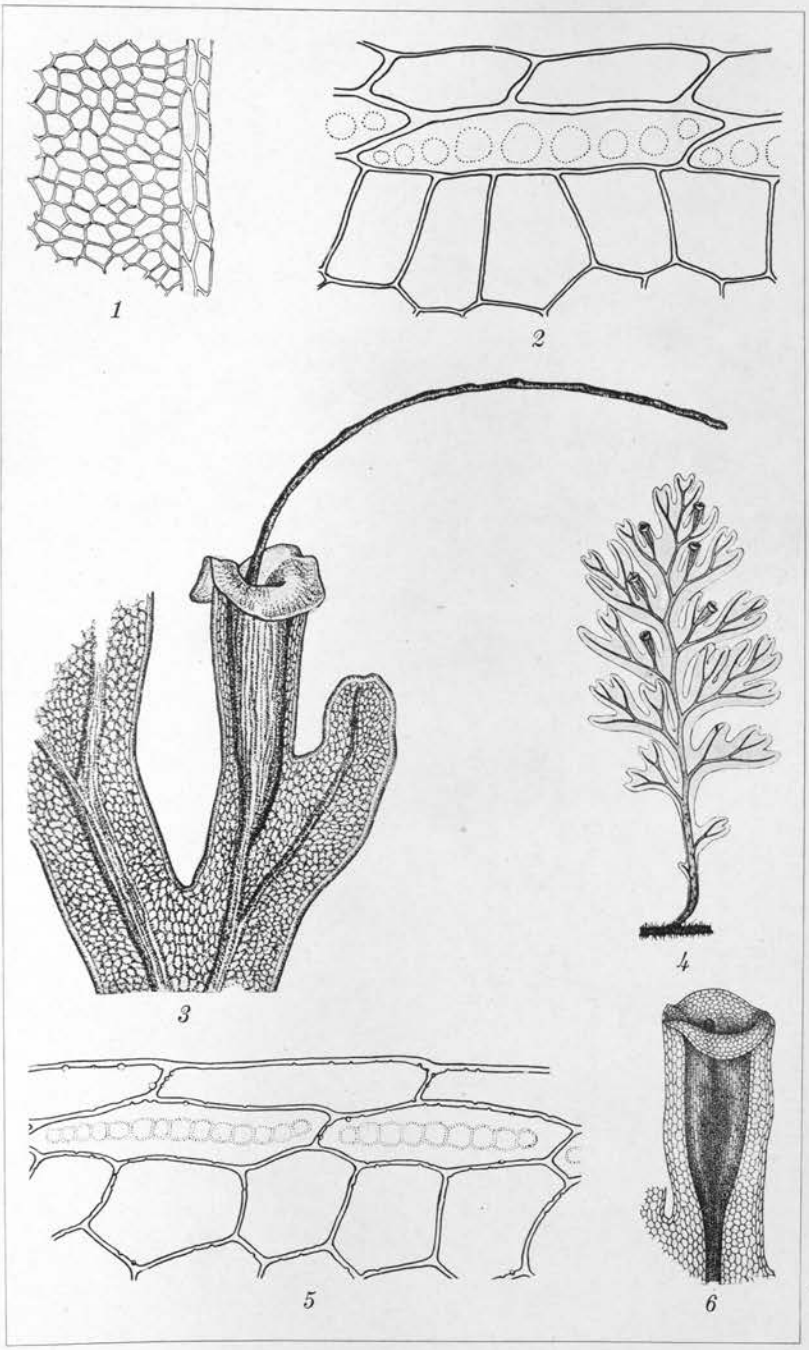


PLATE 12.

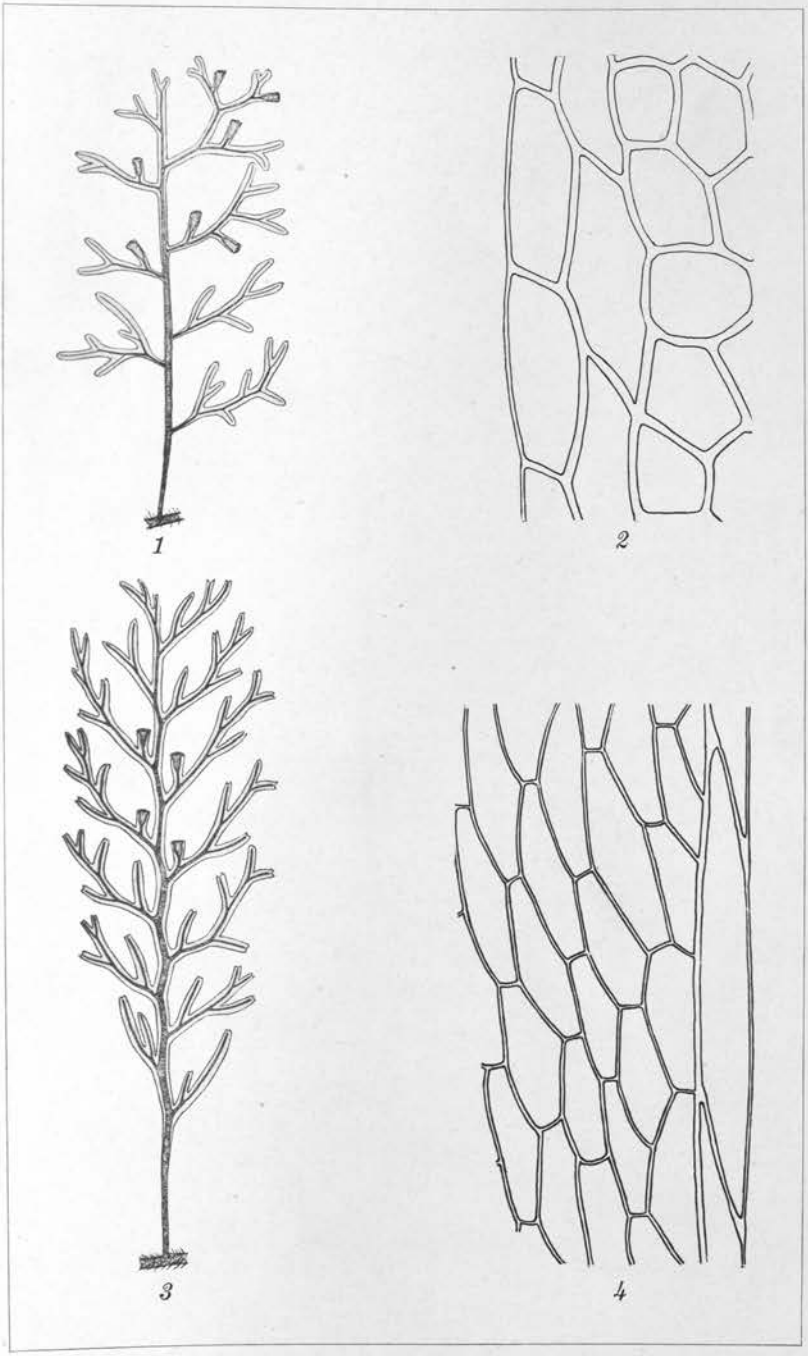


PLATE 13.

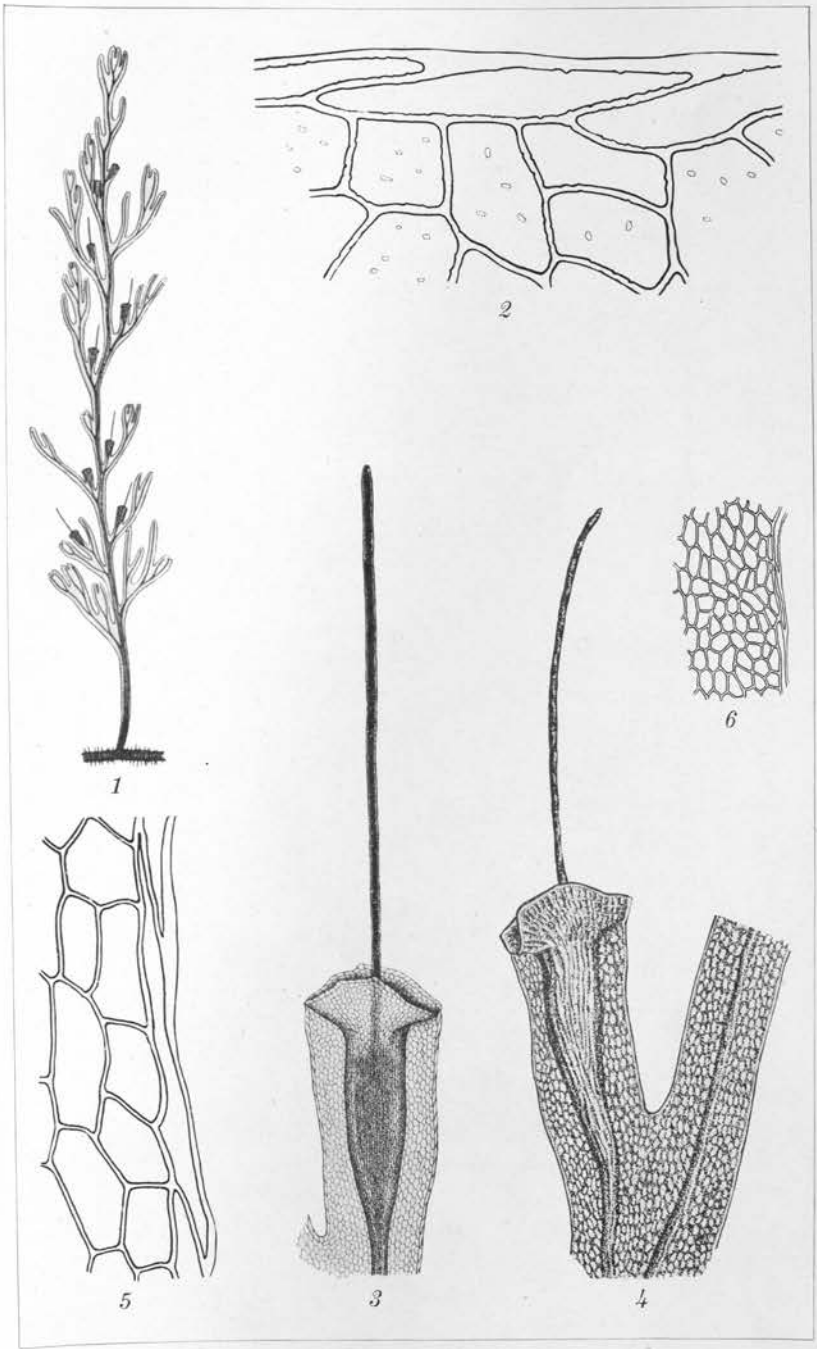


PLATE 14.

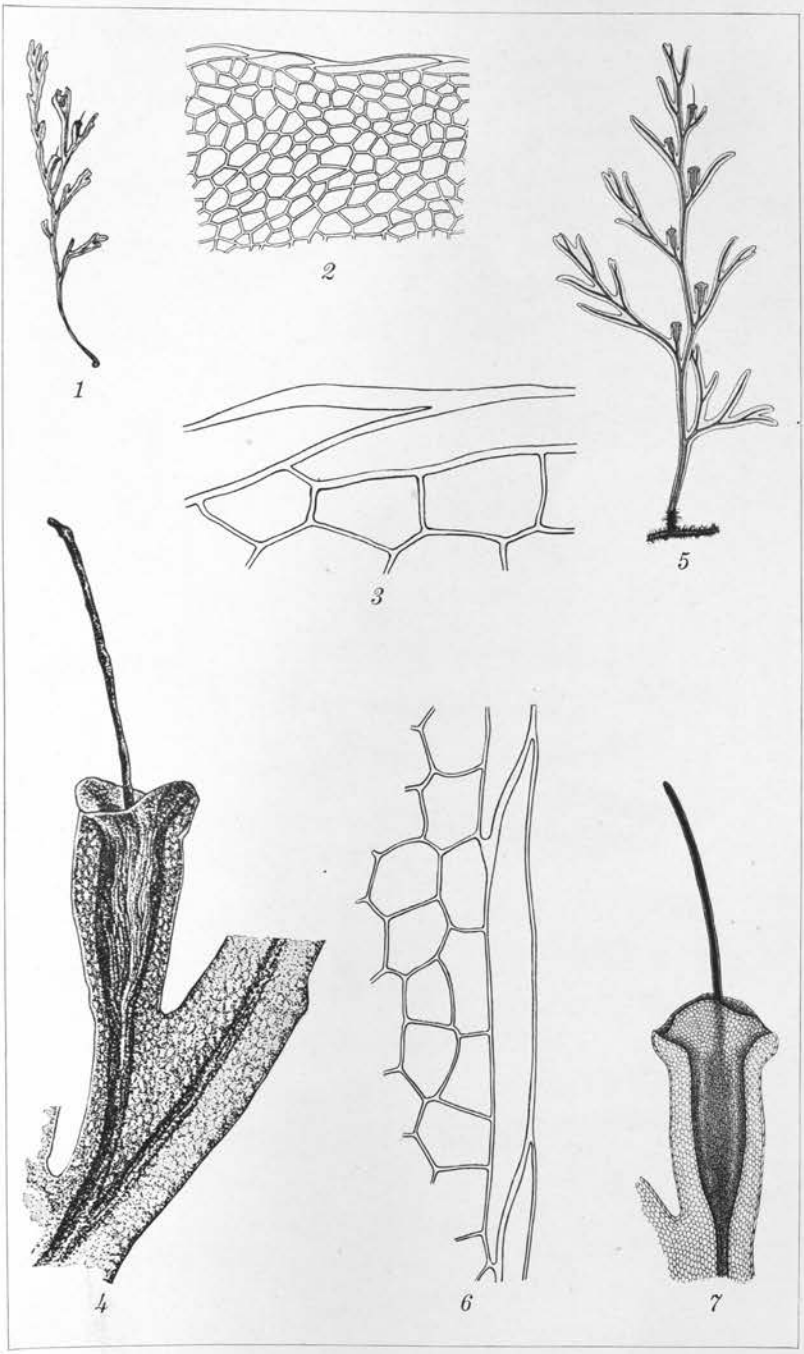


PLATE 15.

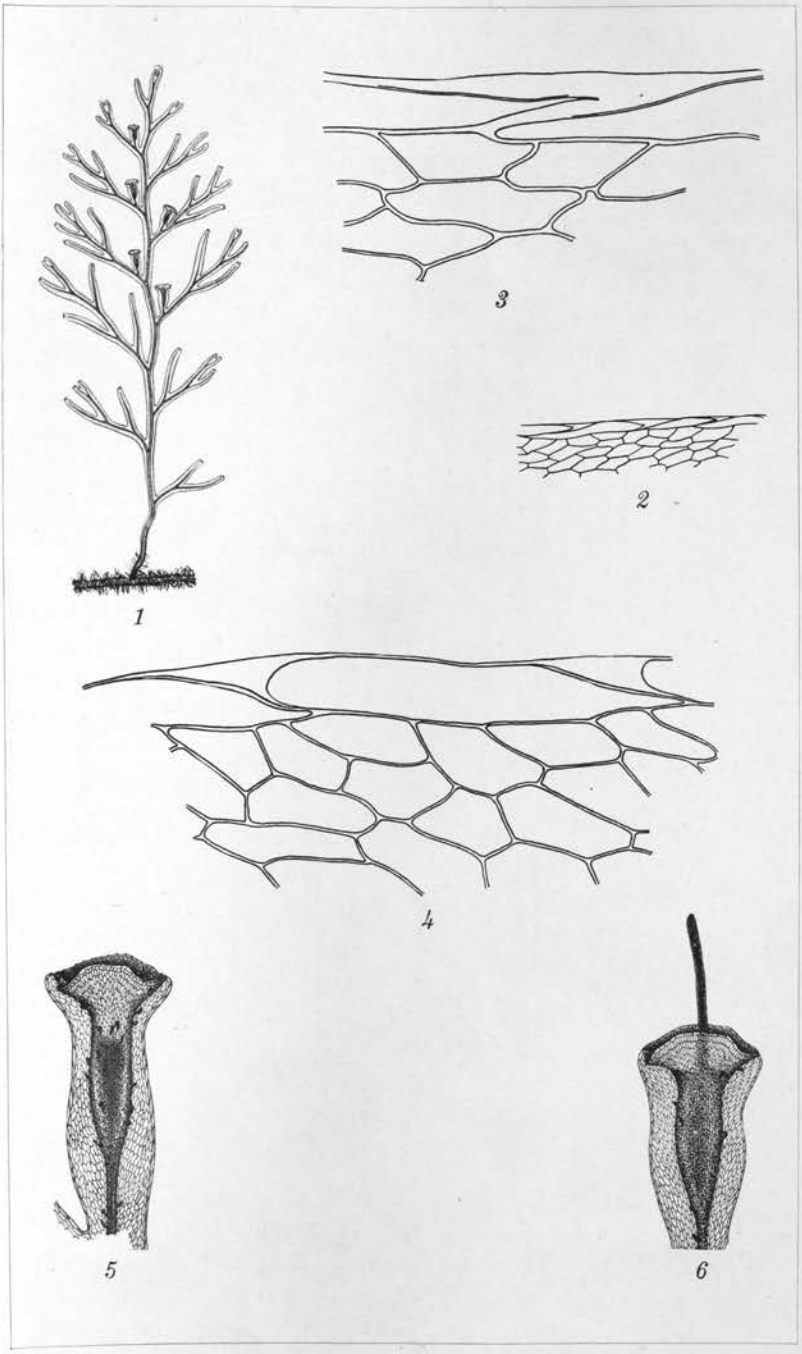


PLATE 16.

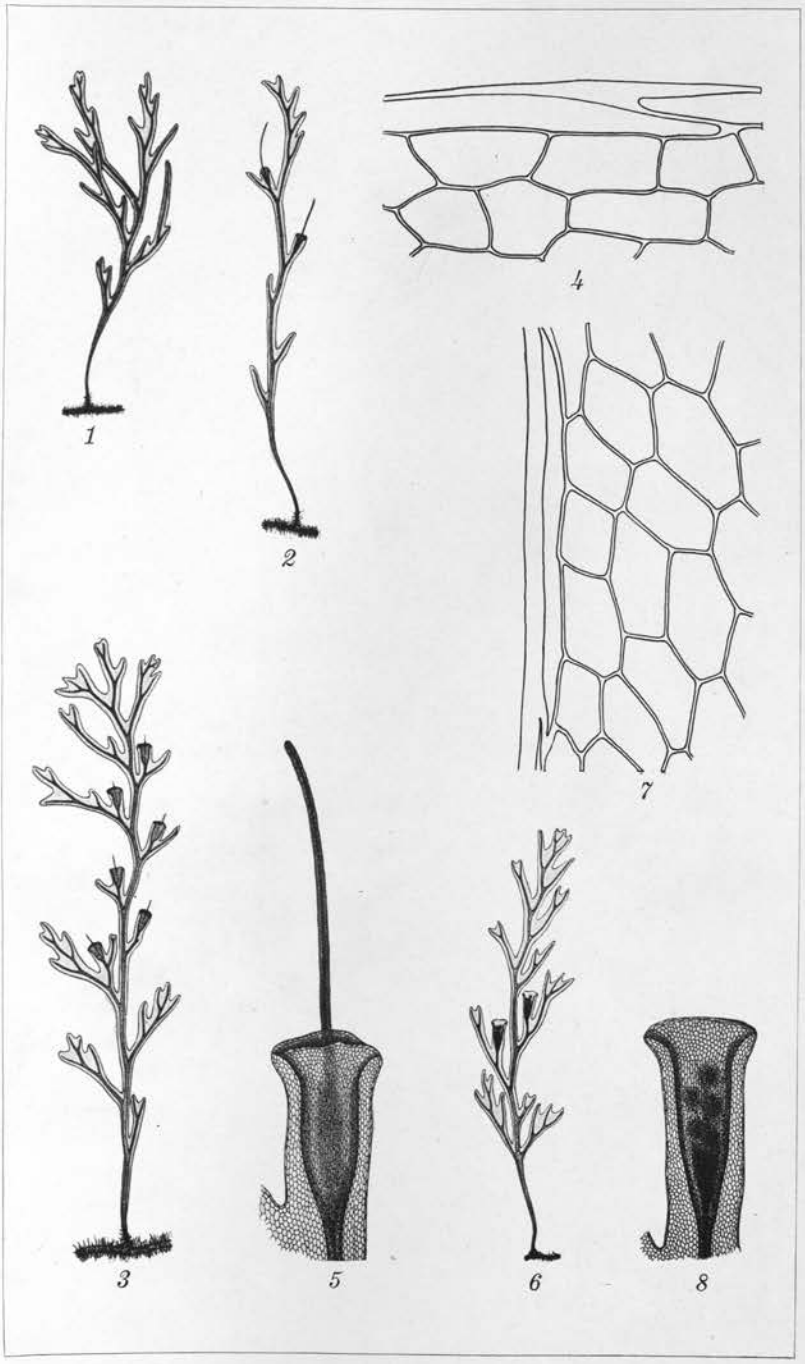


PLATE 17.

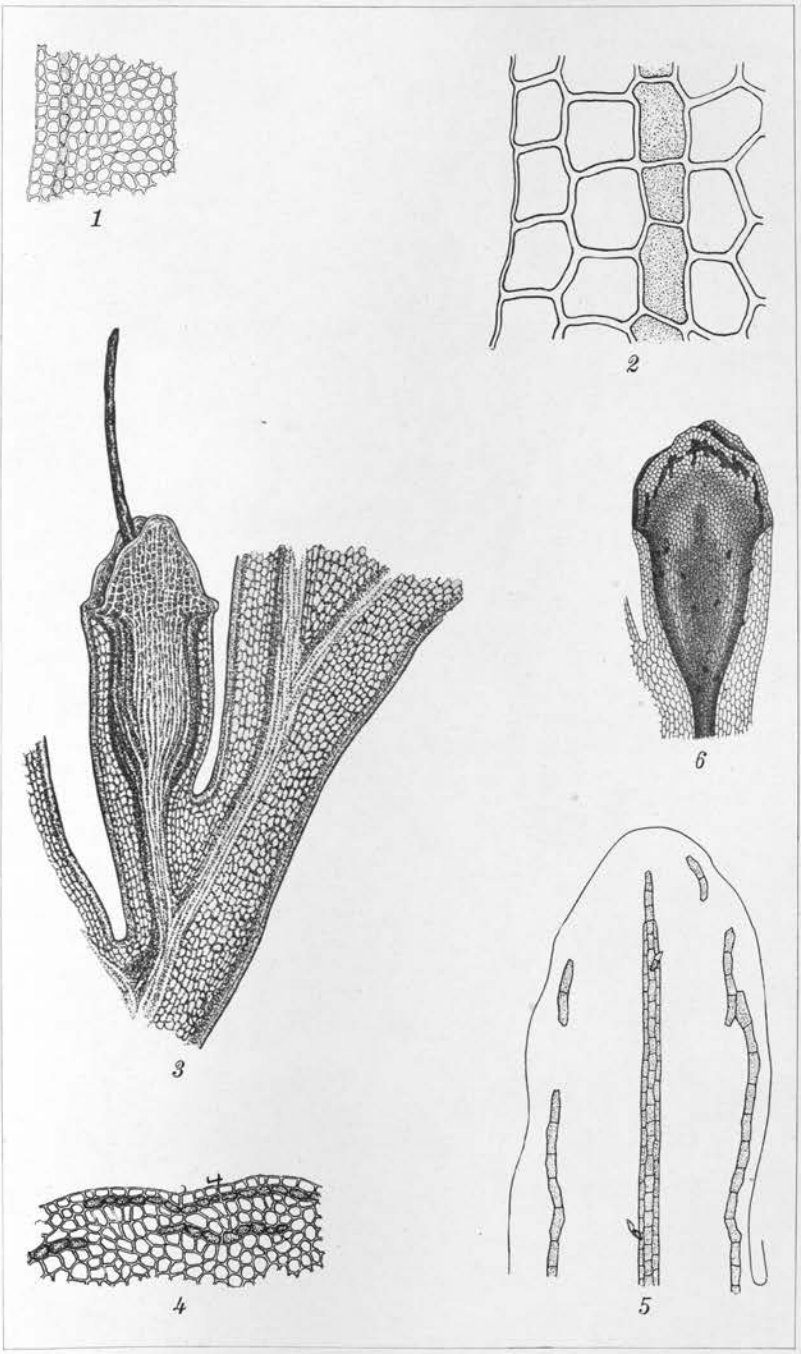


PLATE 18.

PLATE 19.

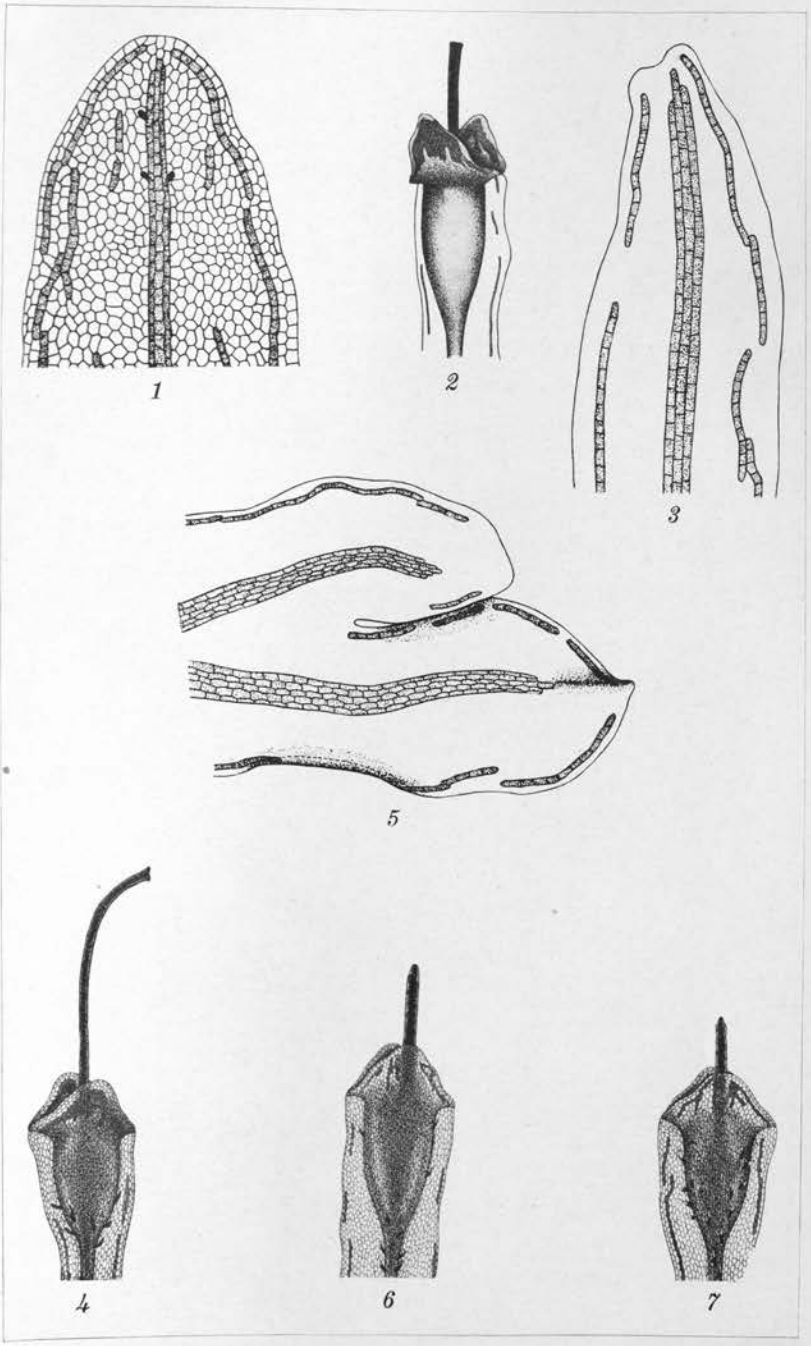


PLATE 20.

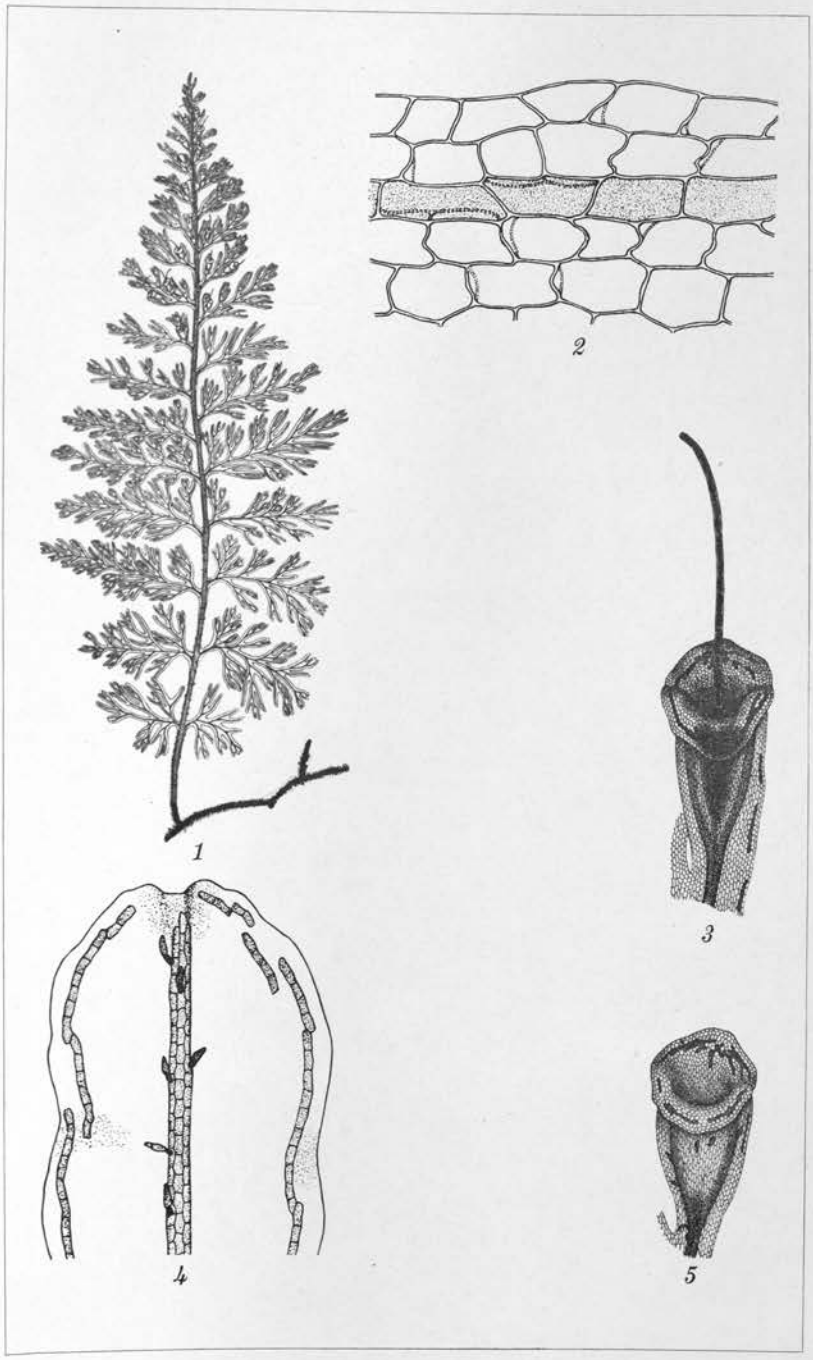


PLATE 21.

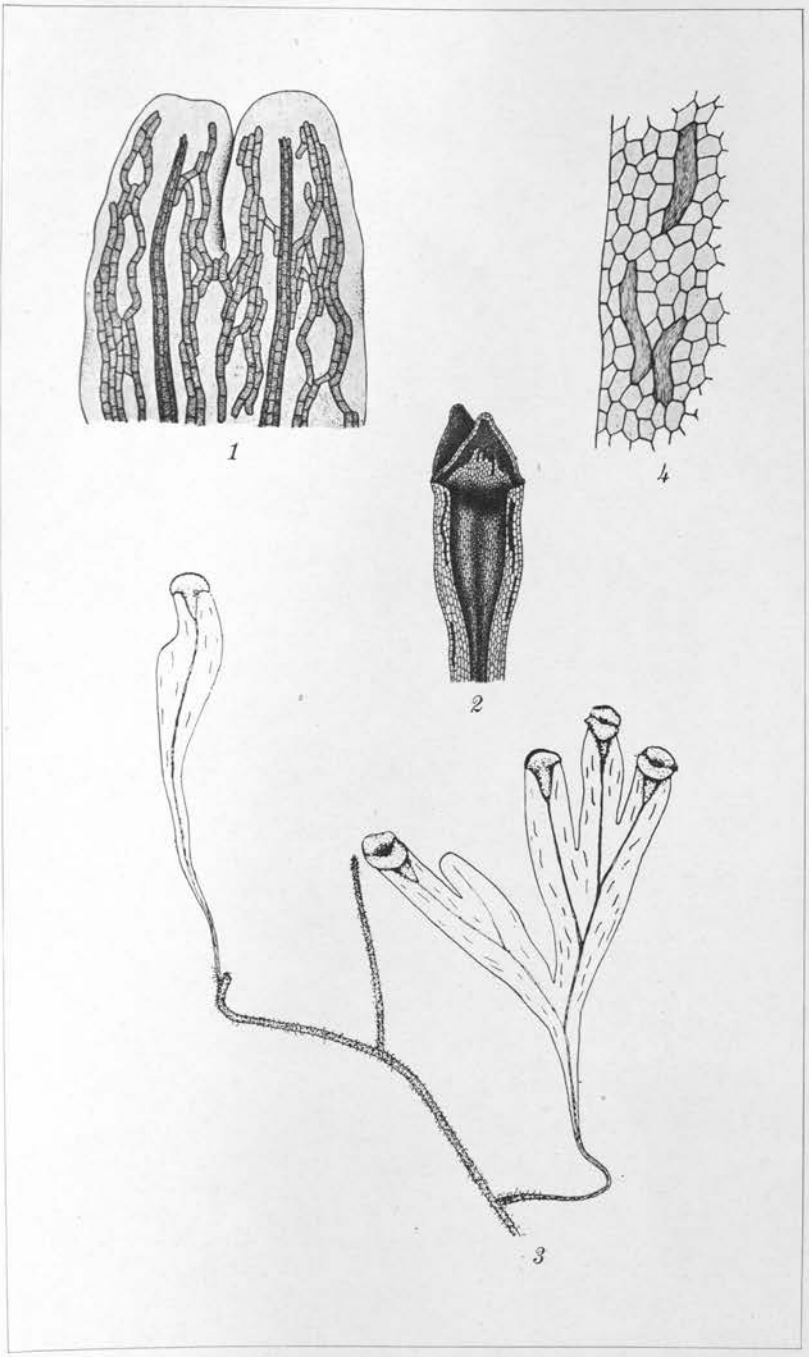
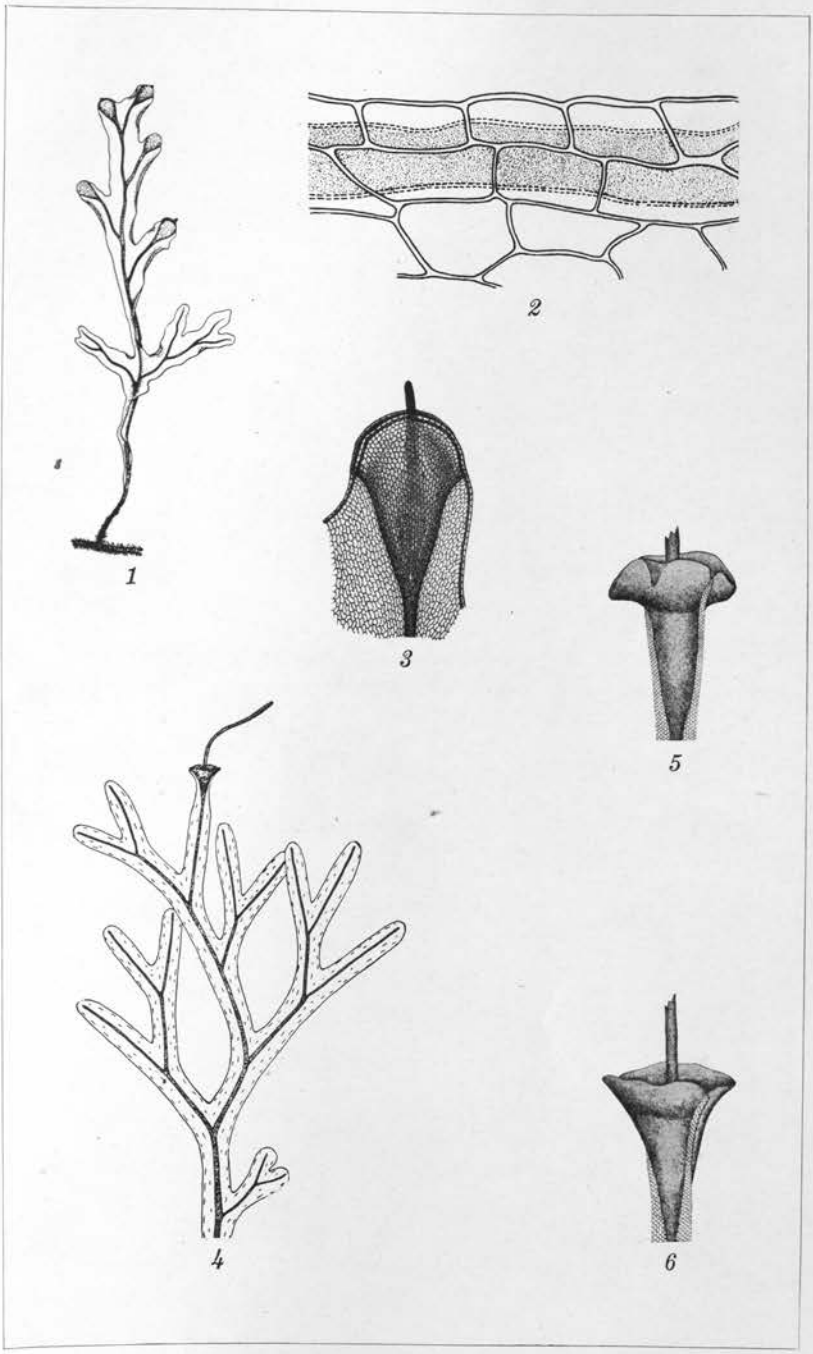


PLATE 22.



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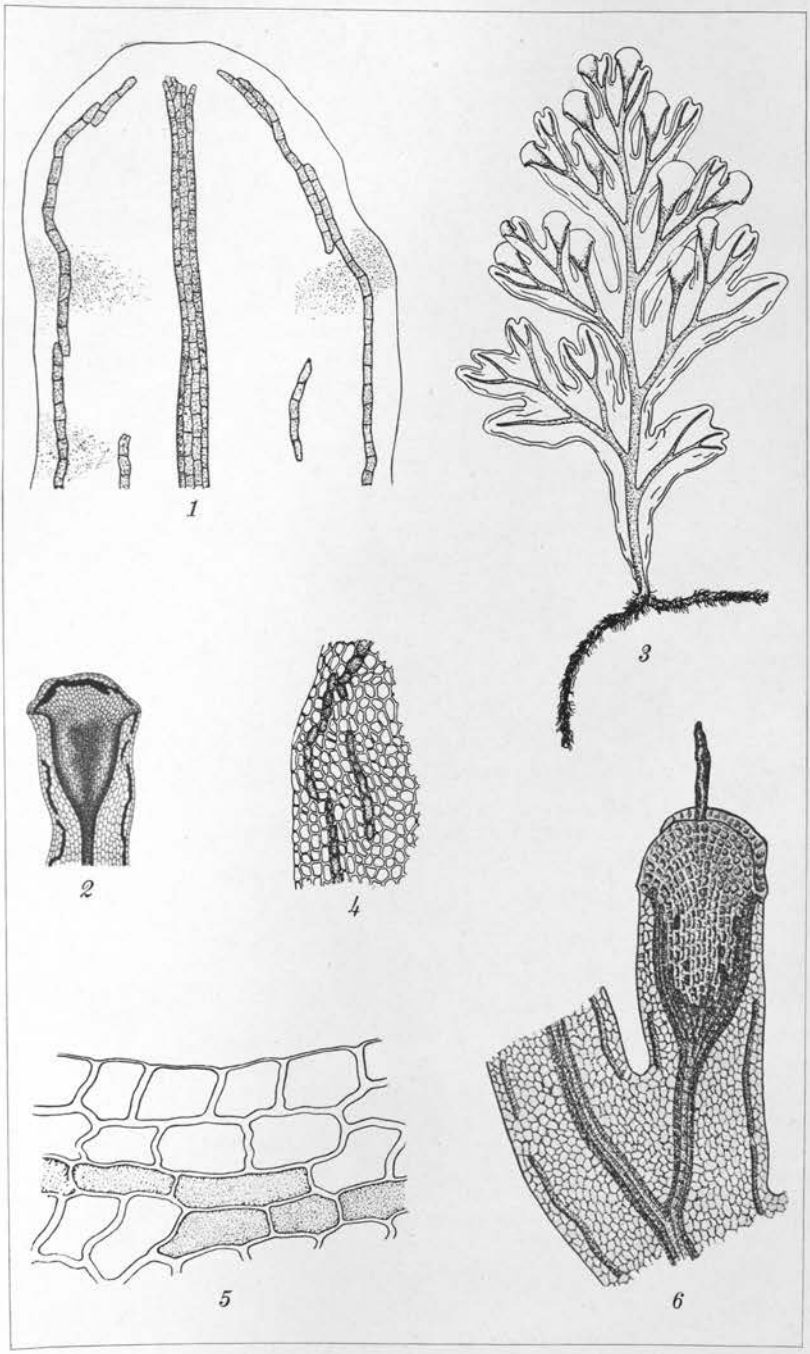

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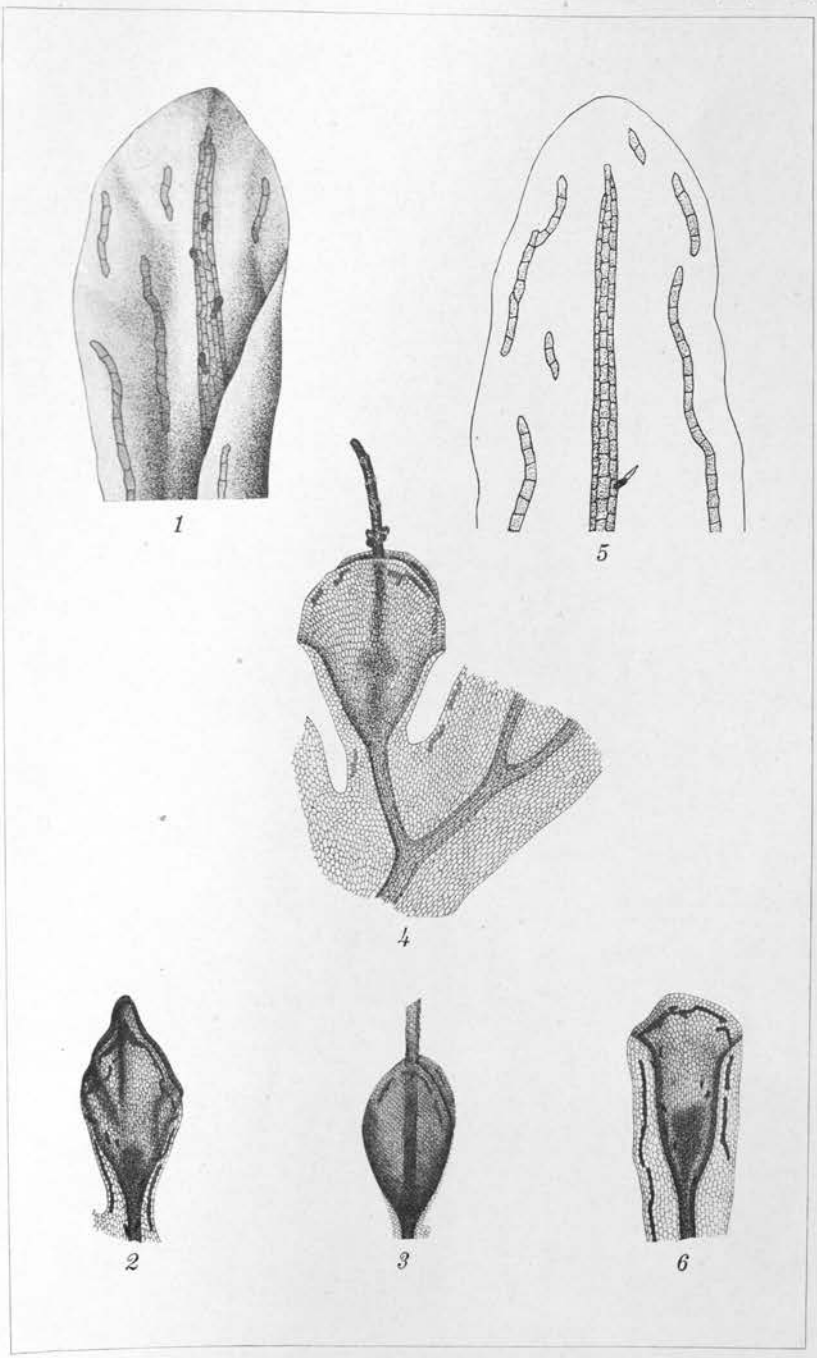

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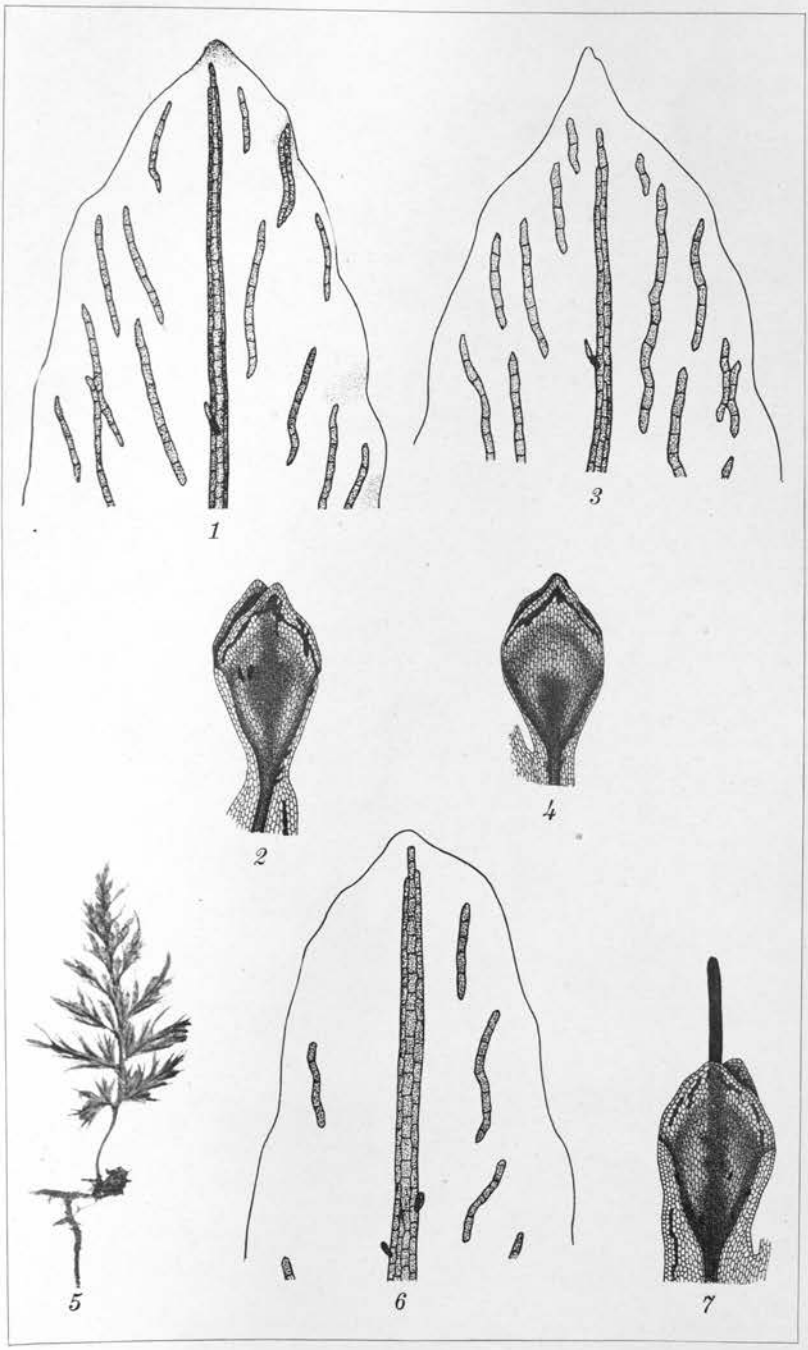

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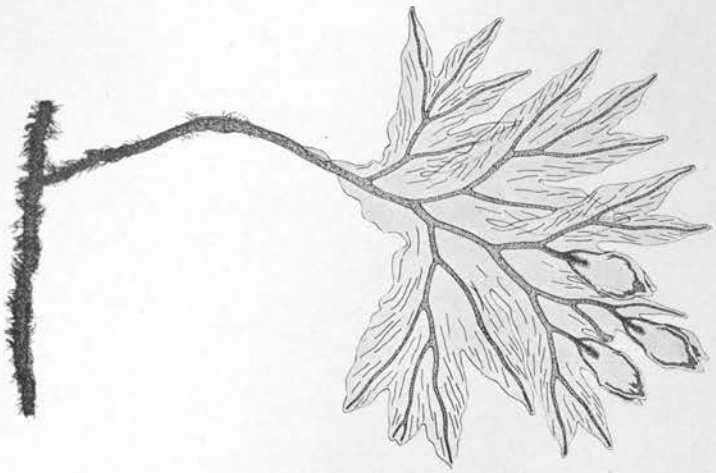

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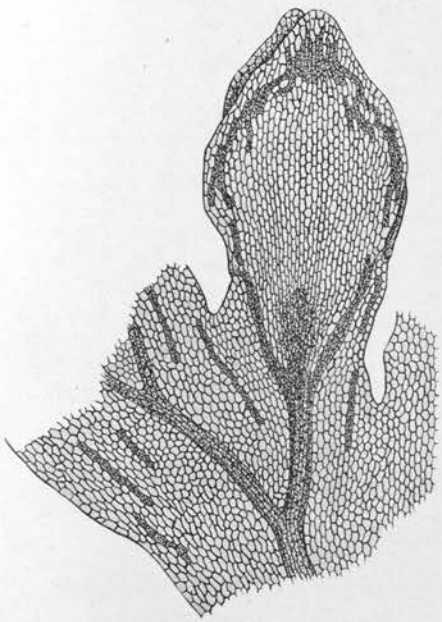

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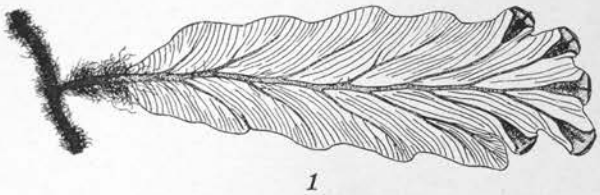

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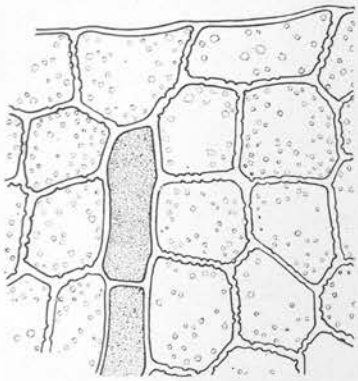

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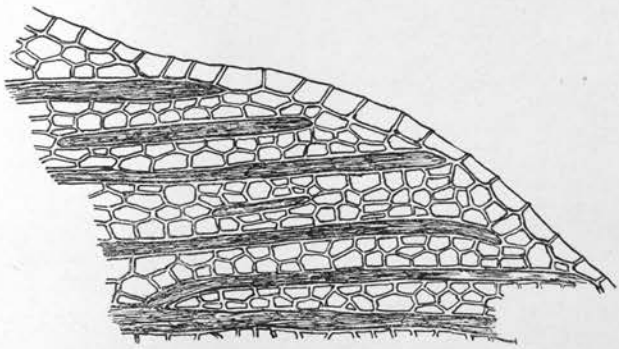

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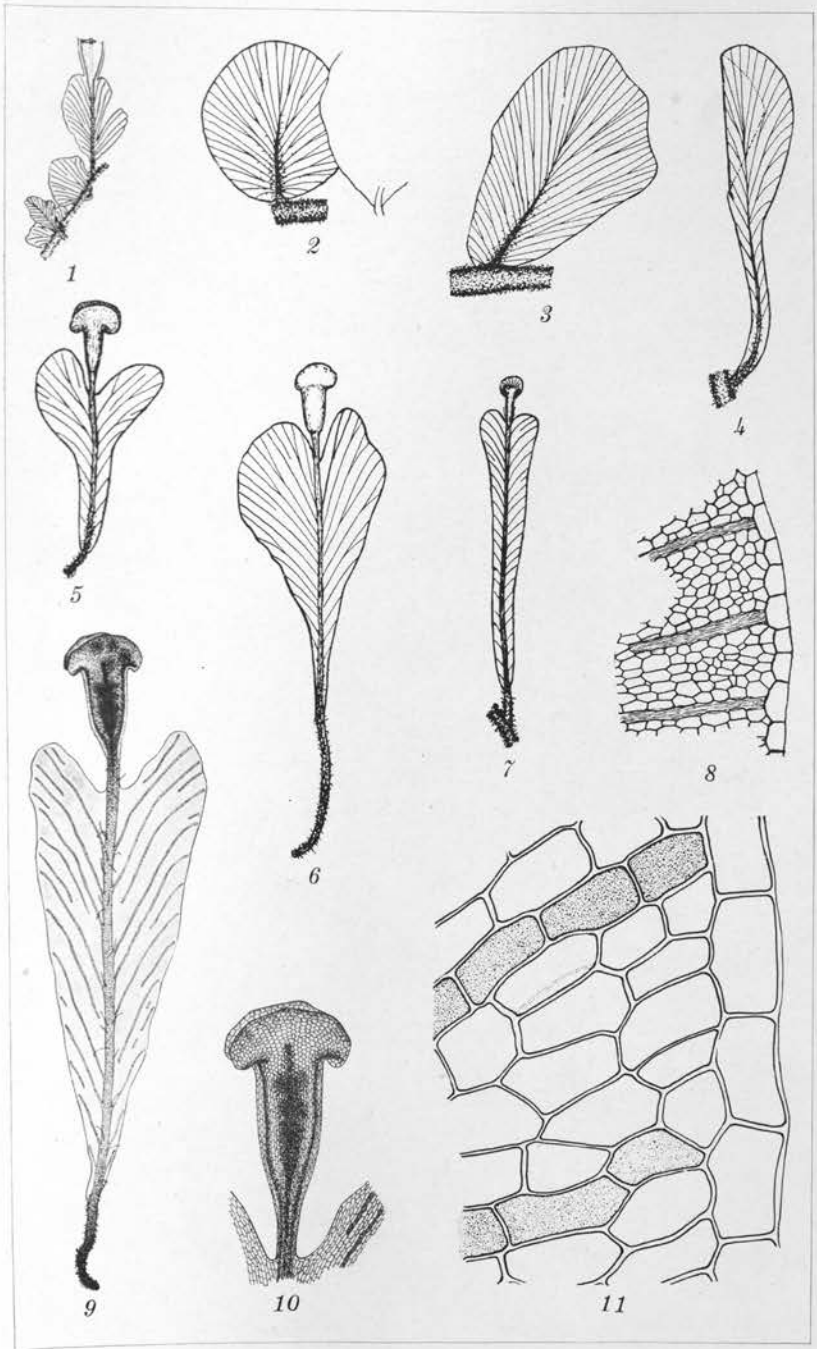

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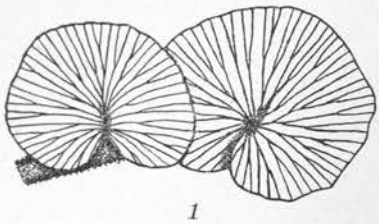

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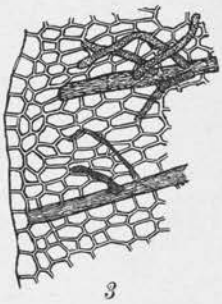

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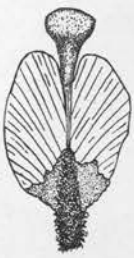

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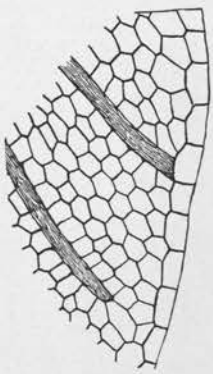

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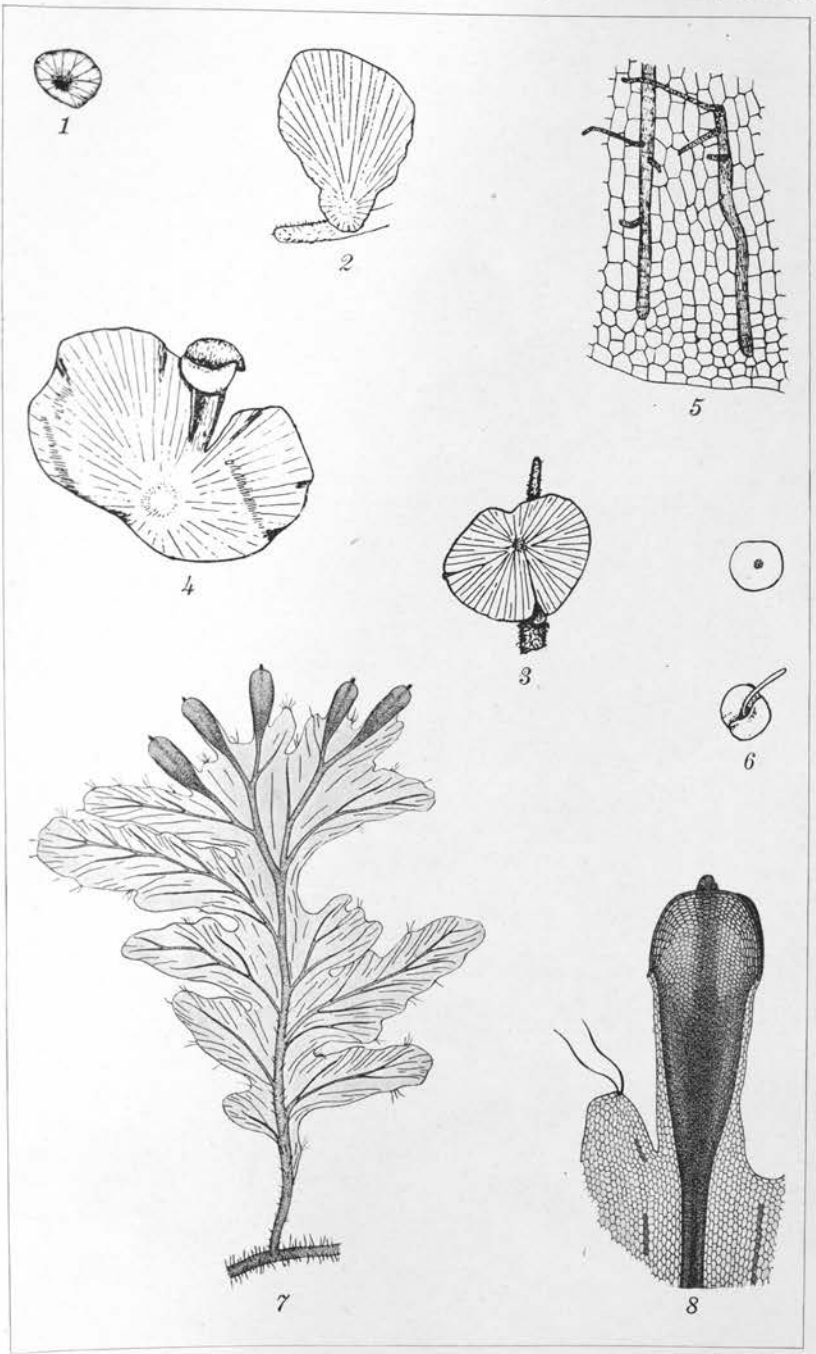

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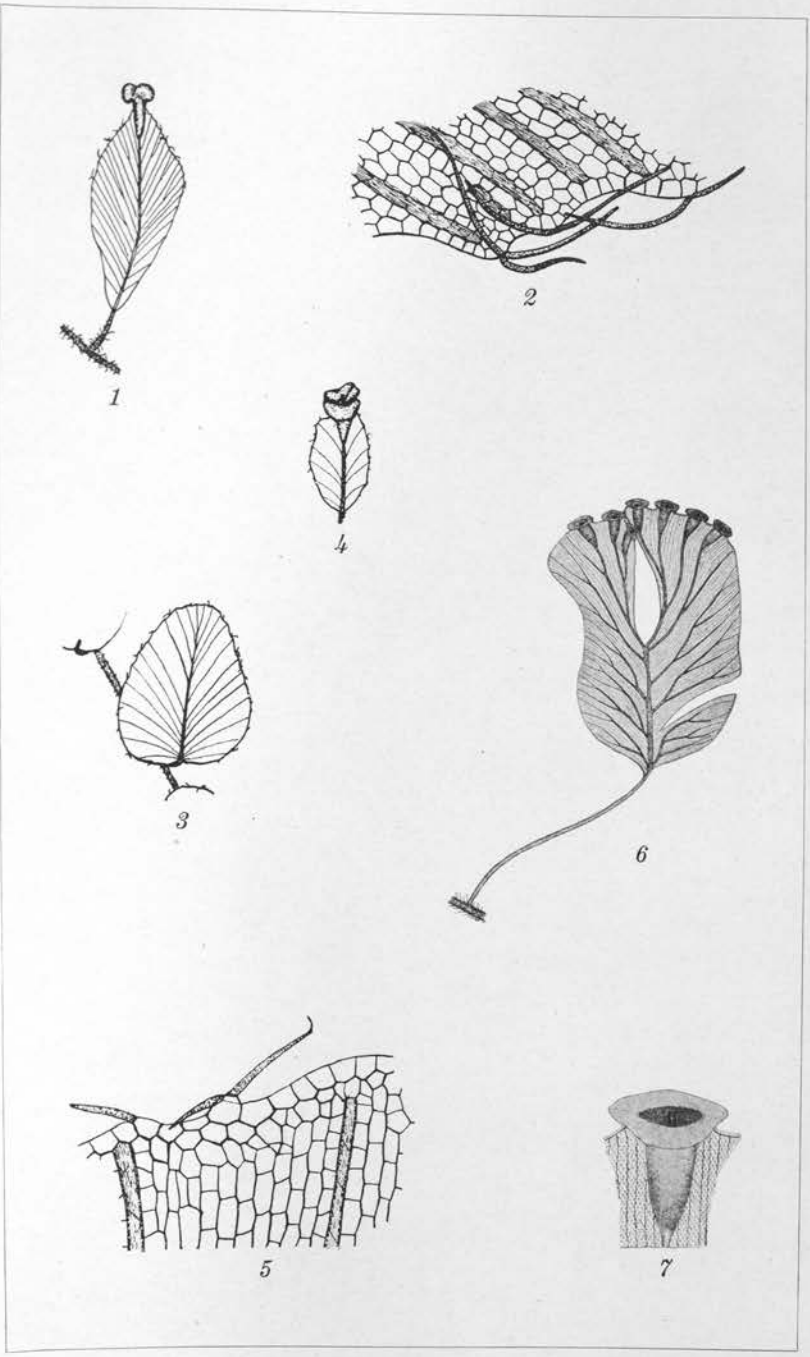

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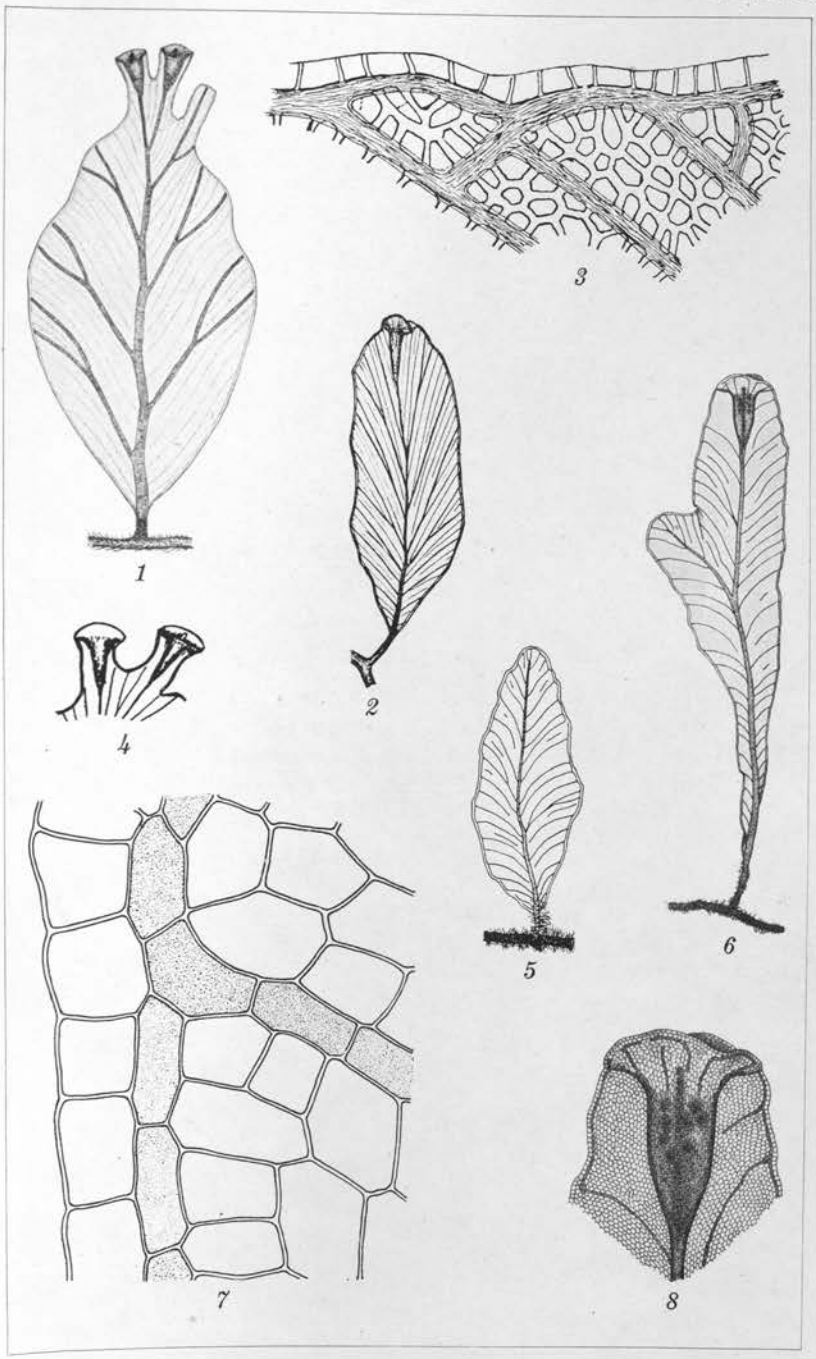

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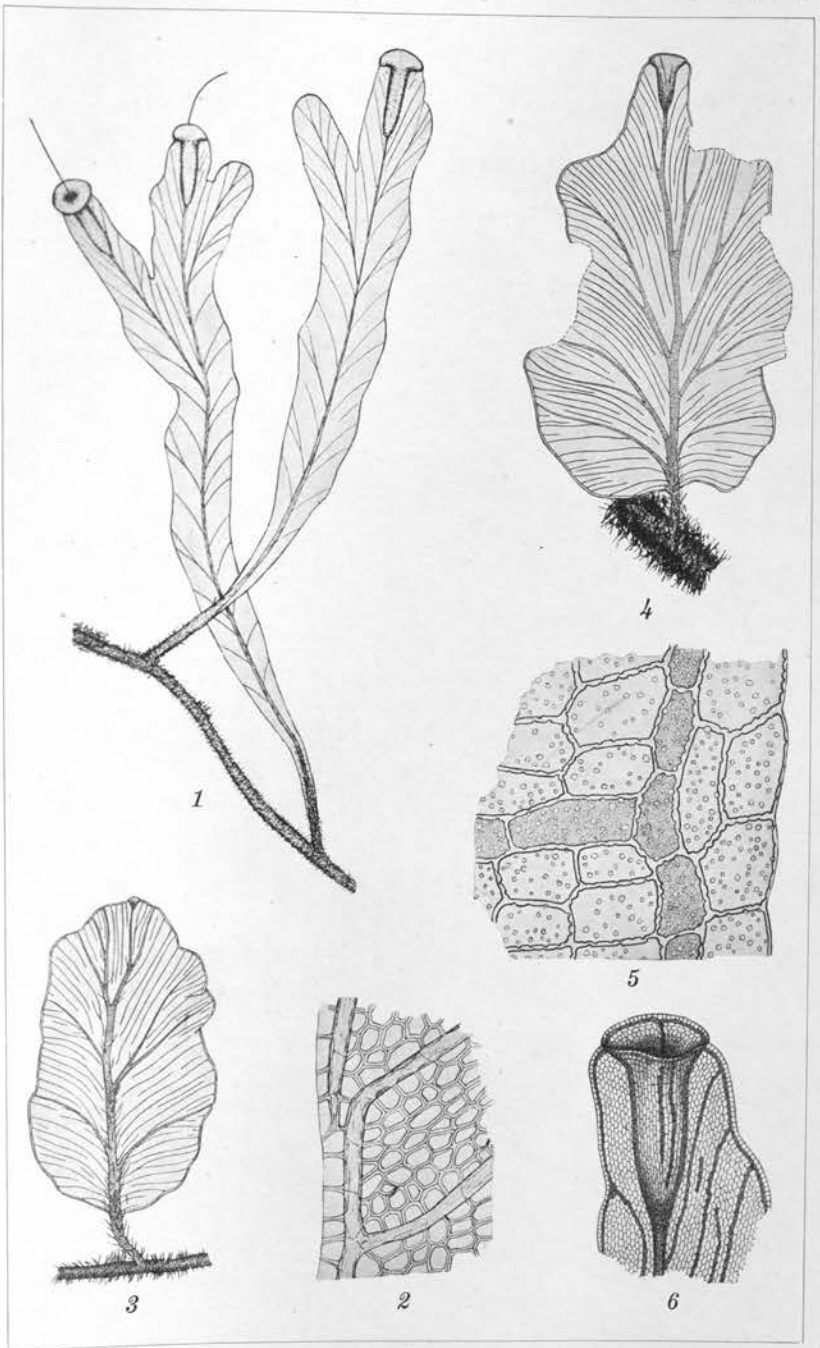

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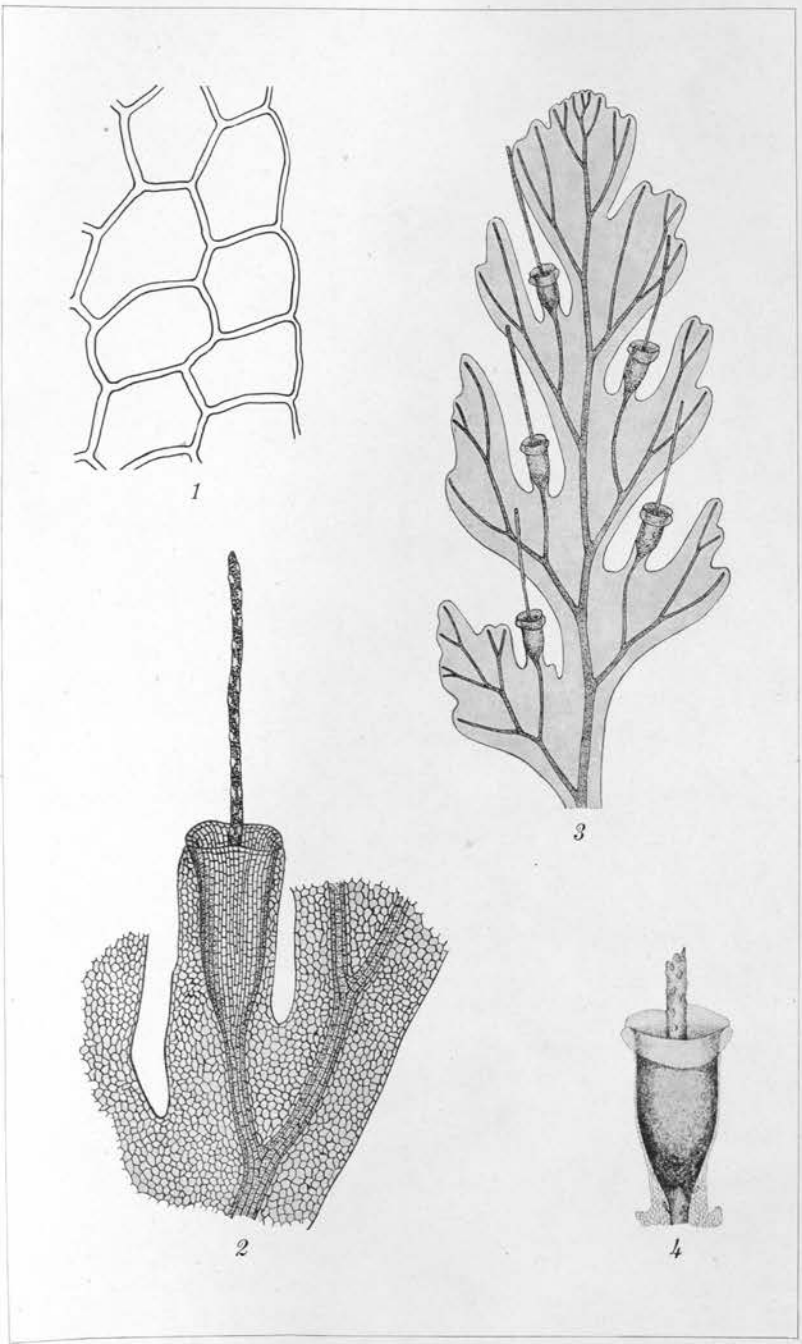

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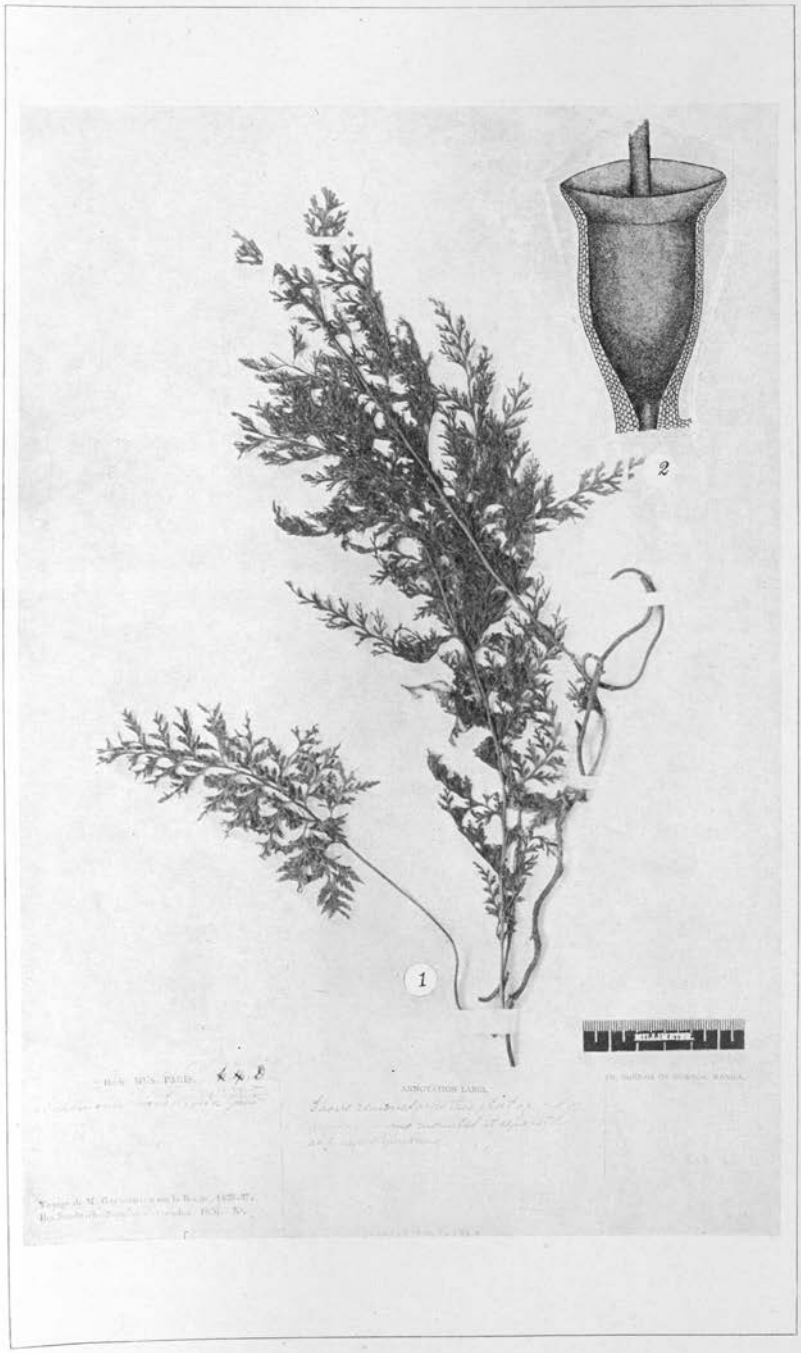

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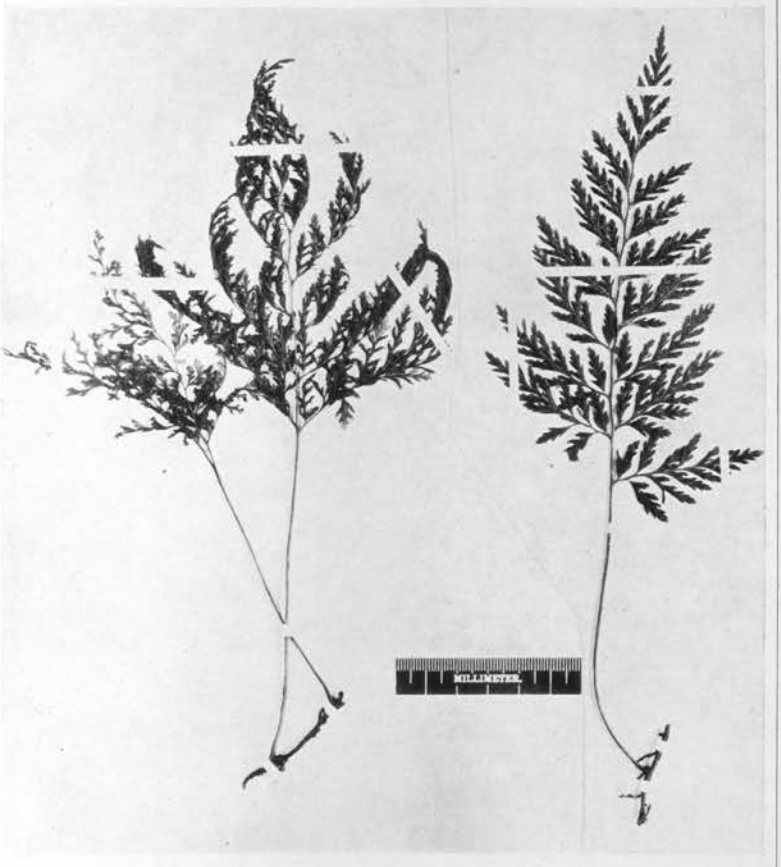

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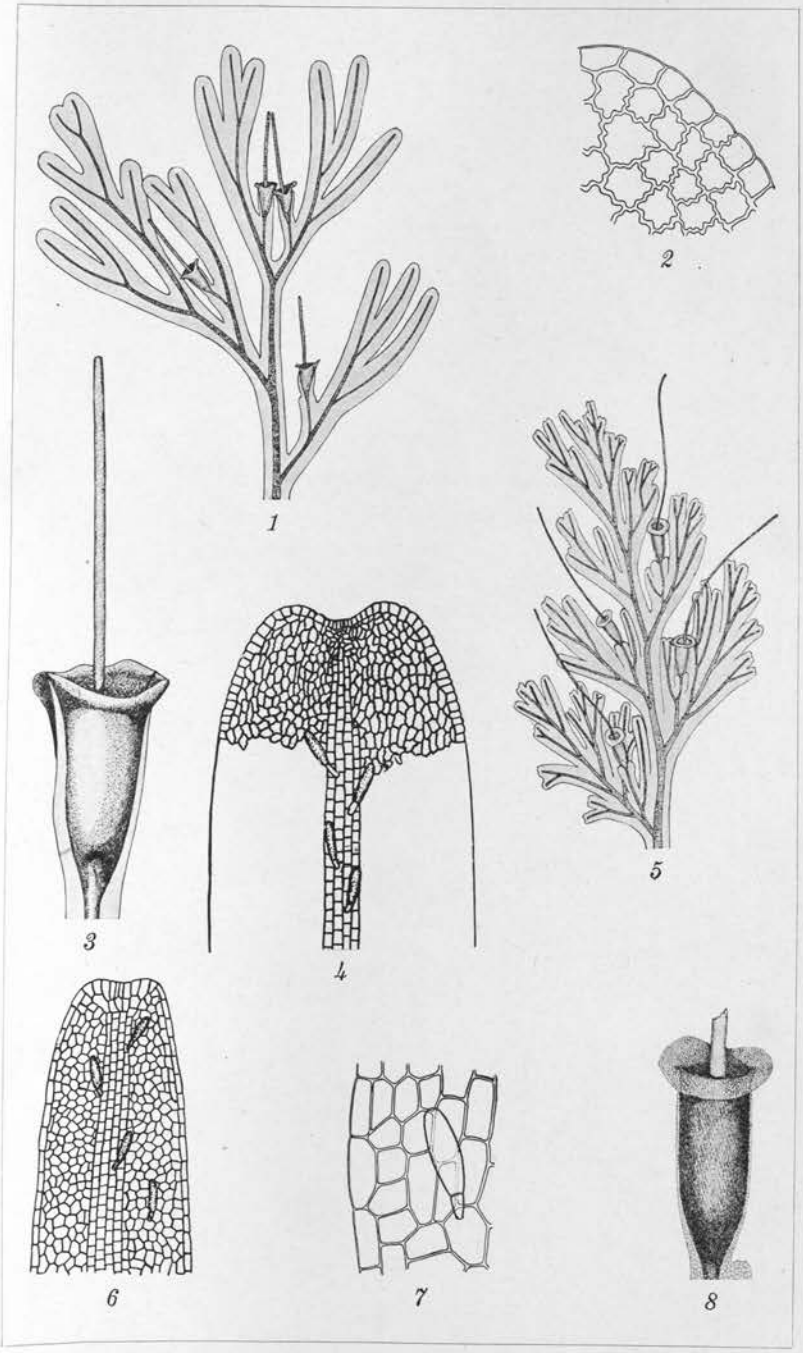

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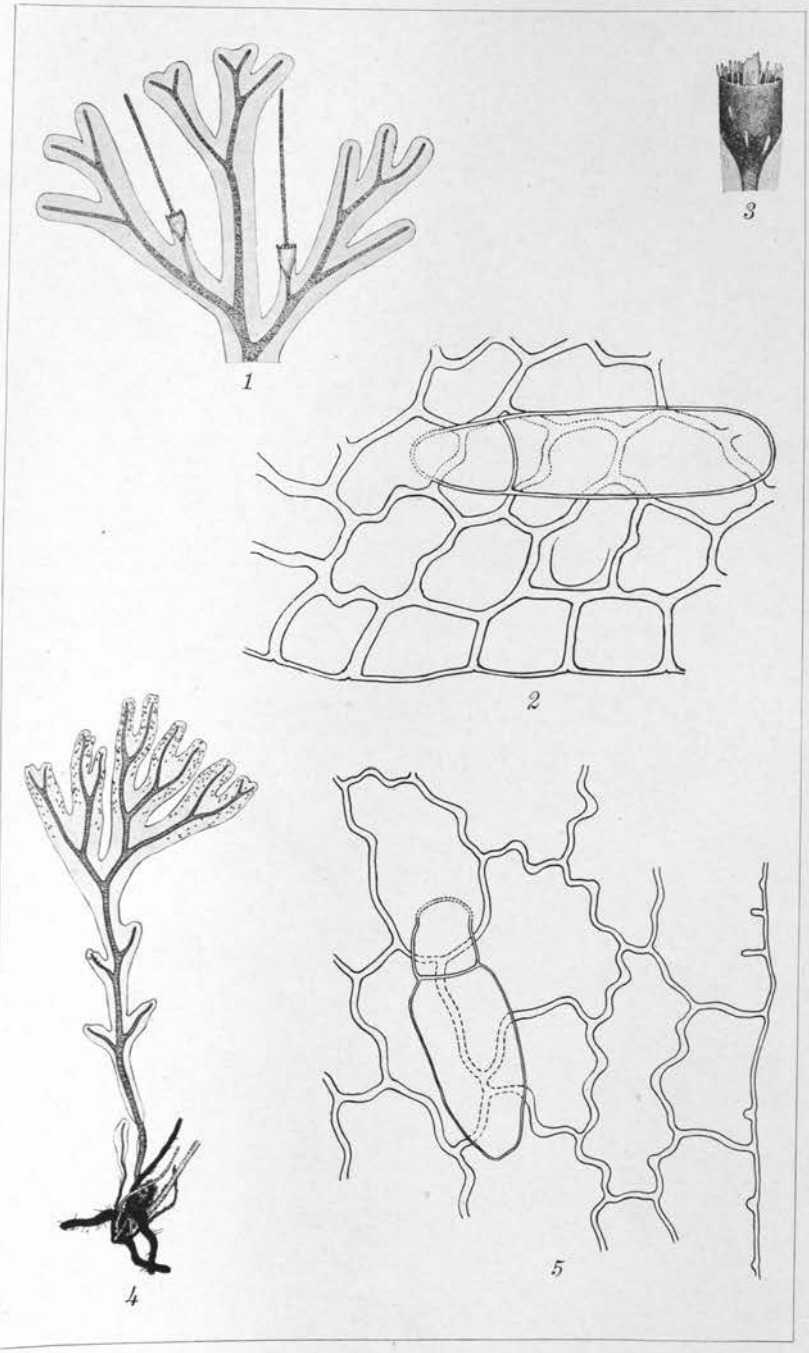

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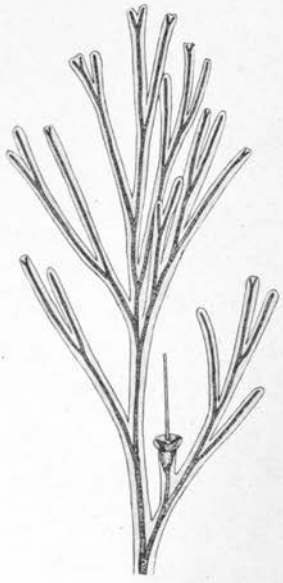

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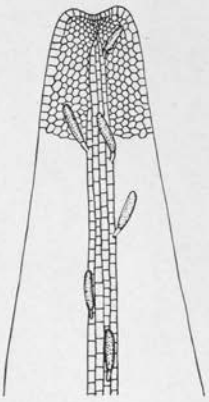

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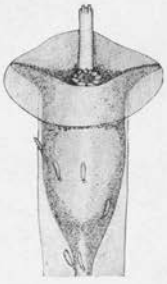

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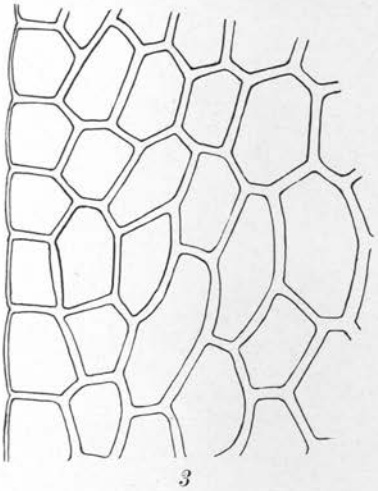

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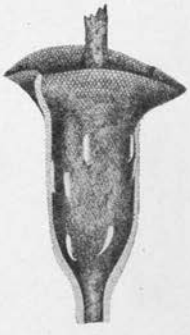

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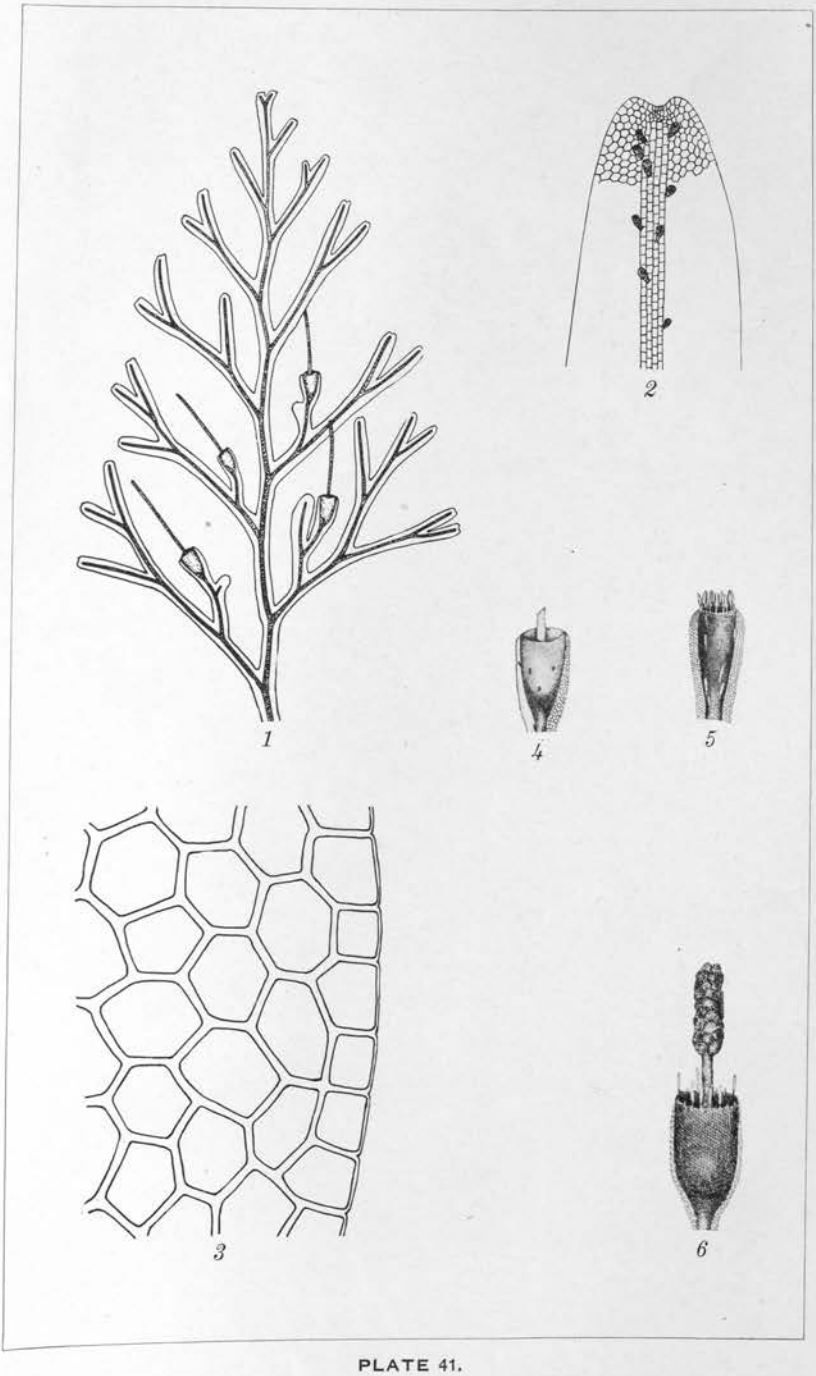

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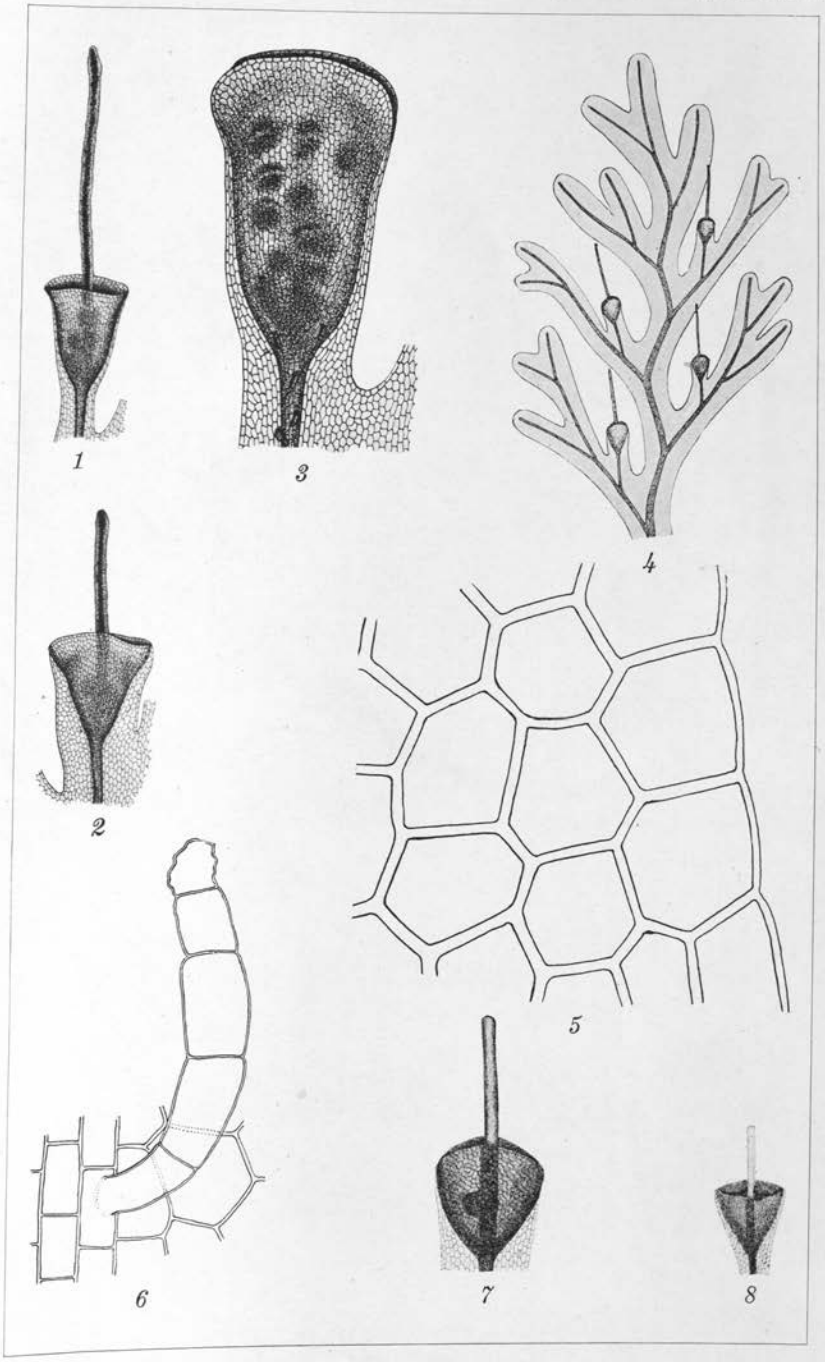

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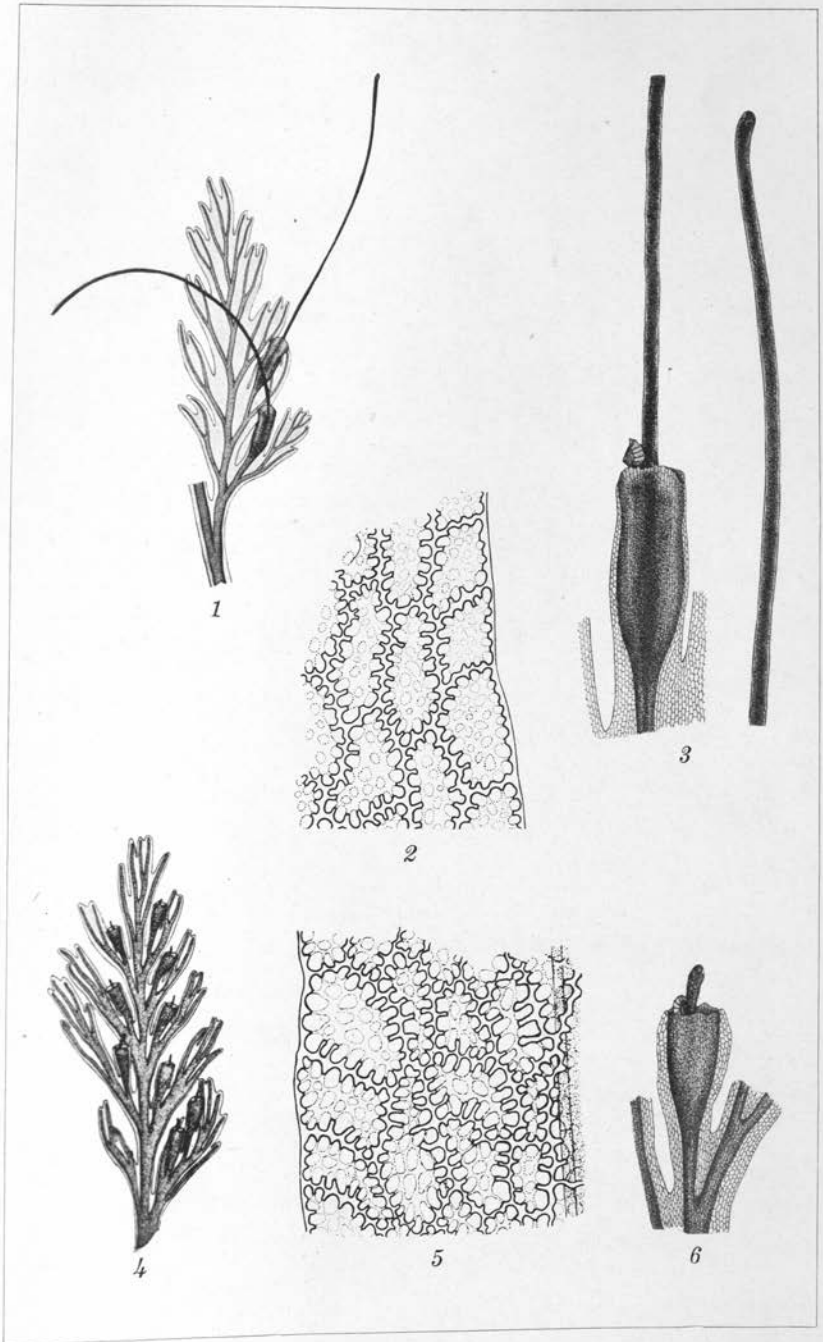

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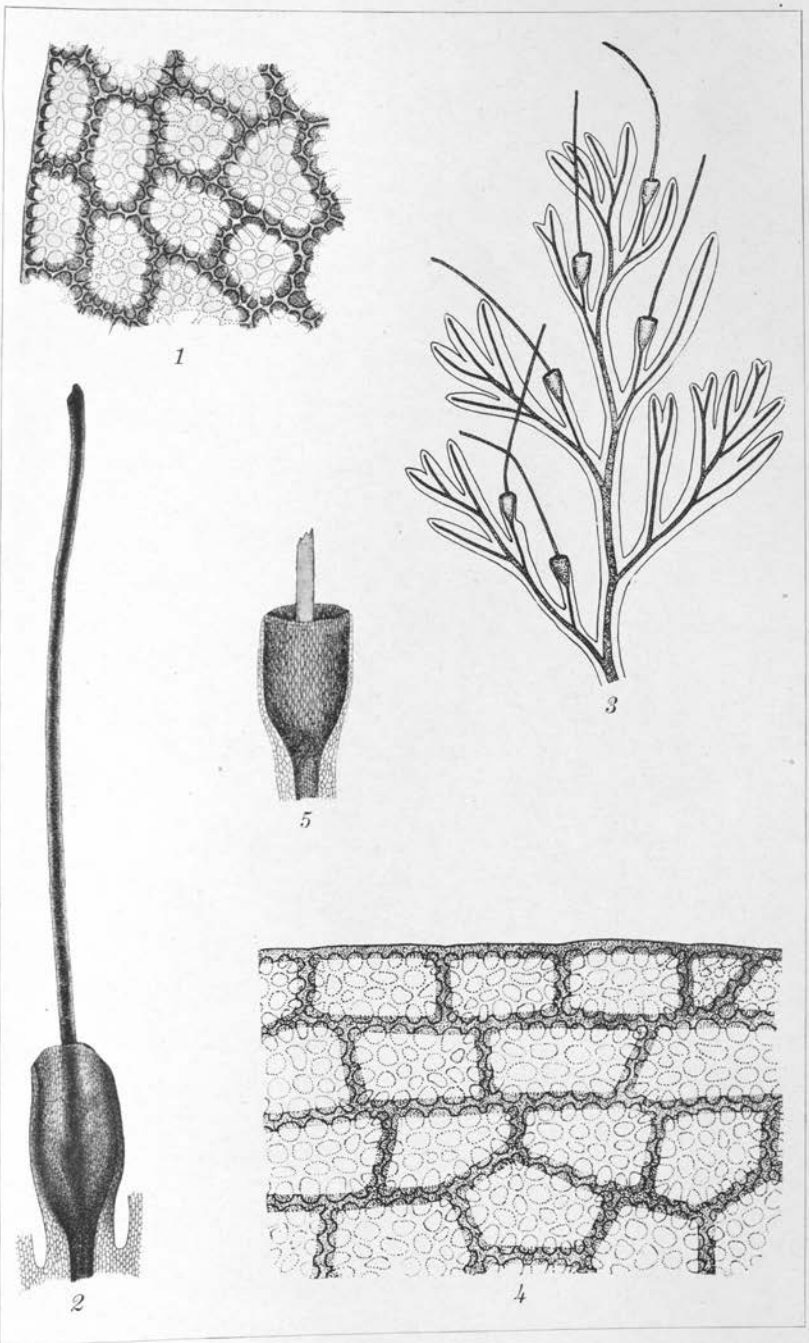

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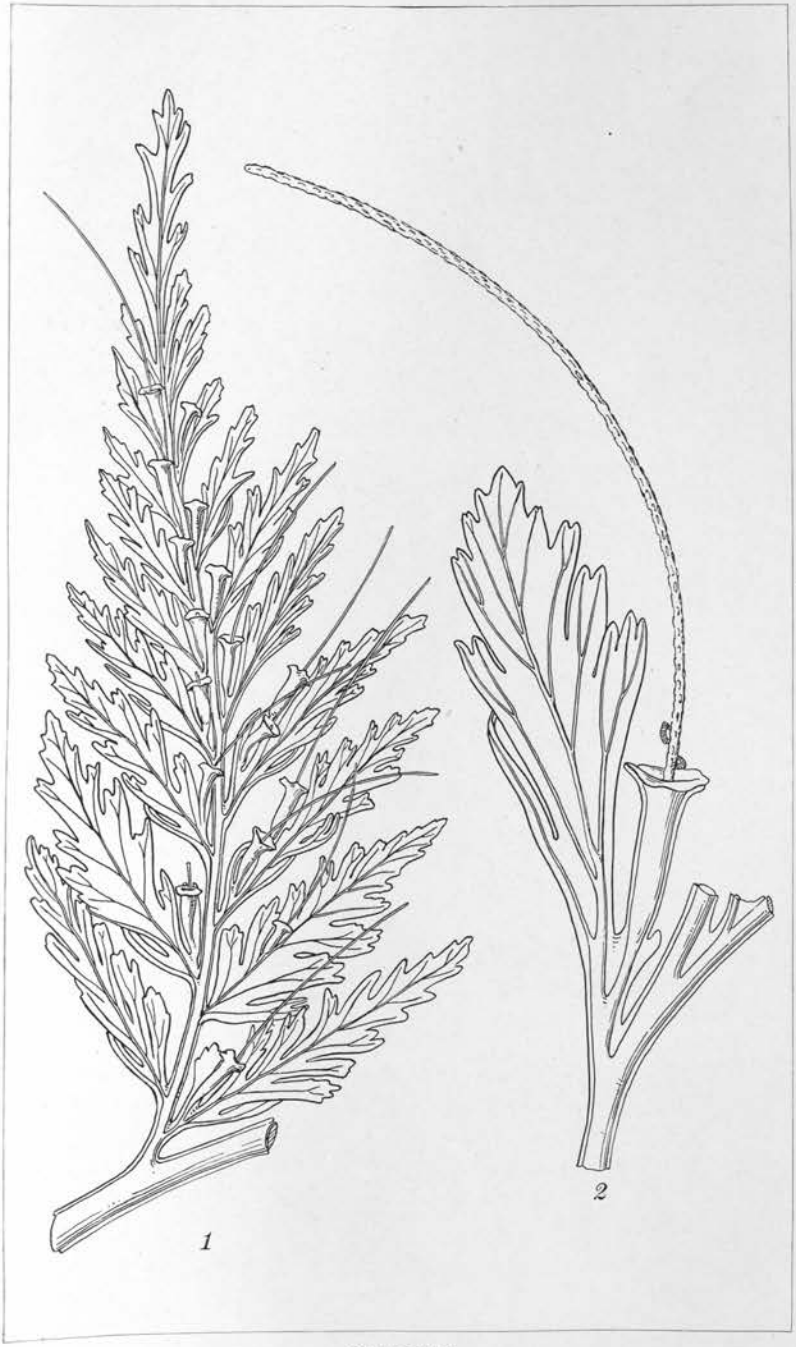

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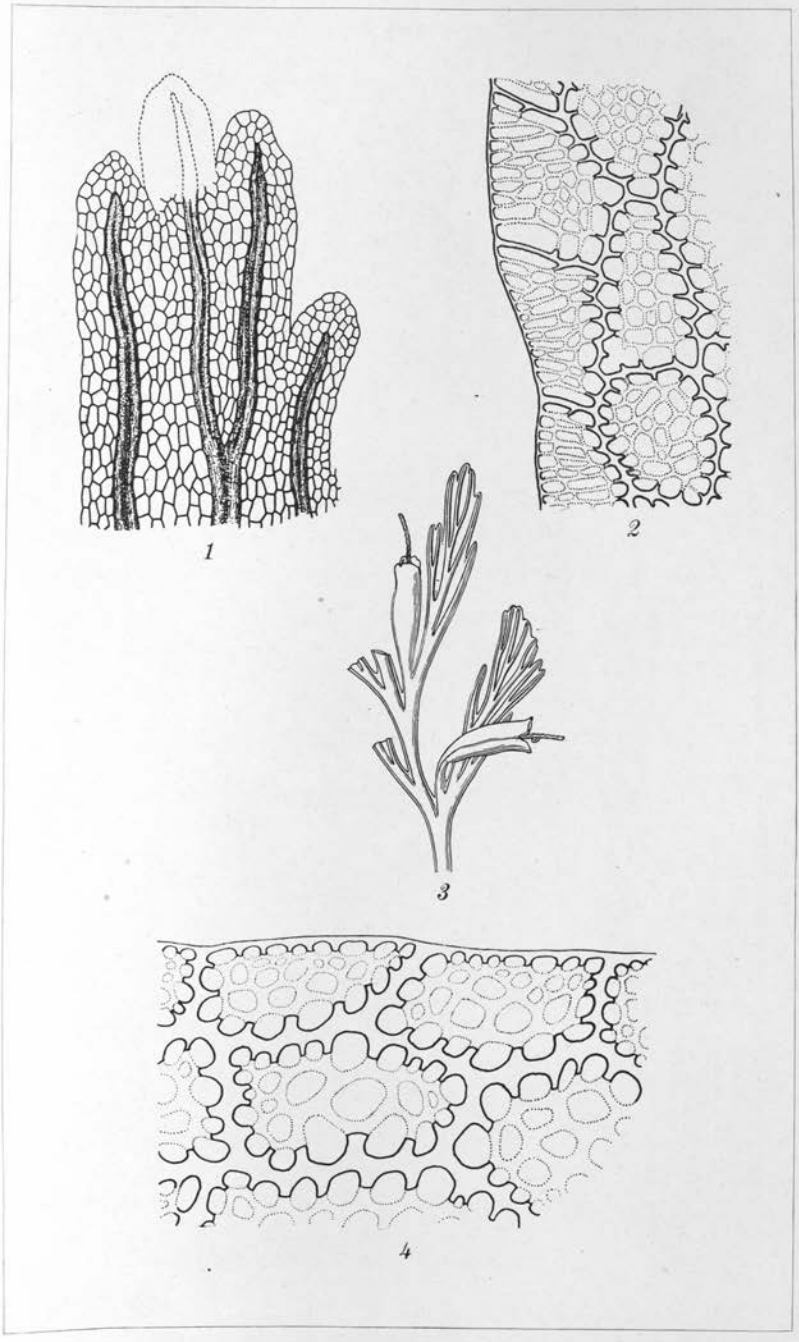

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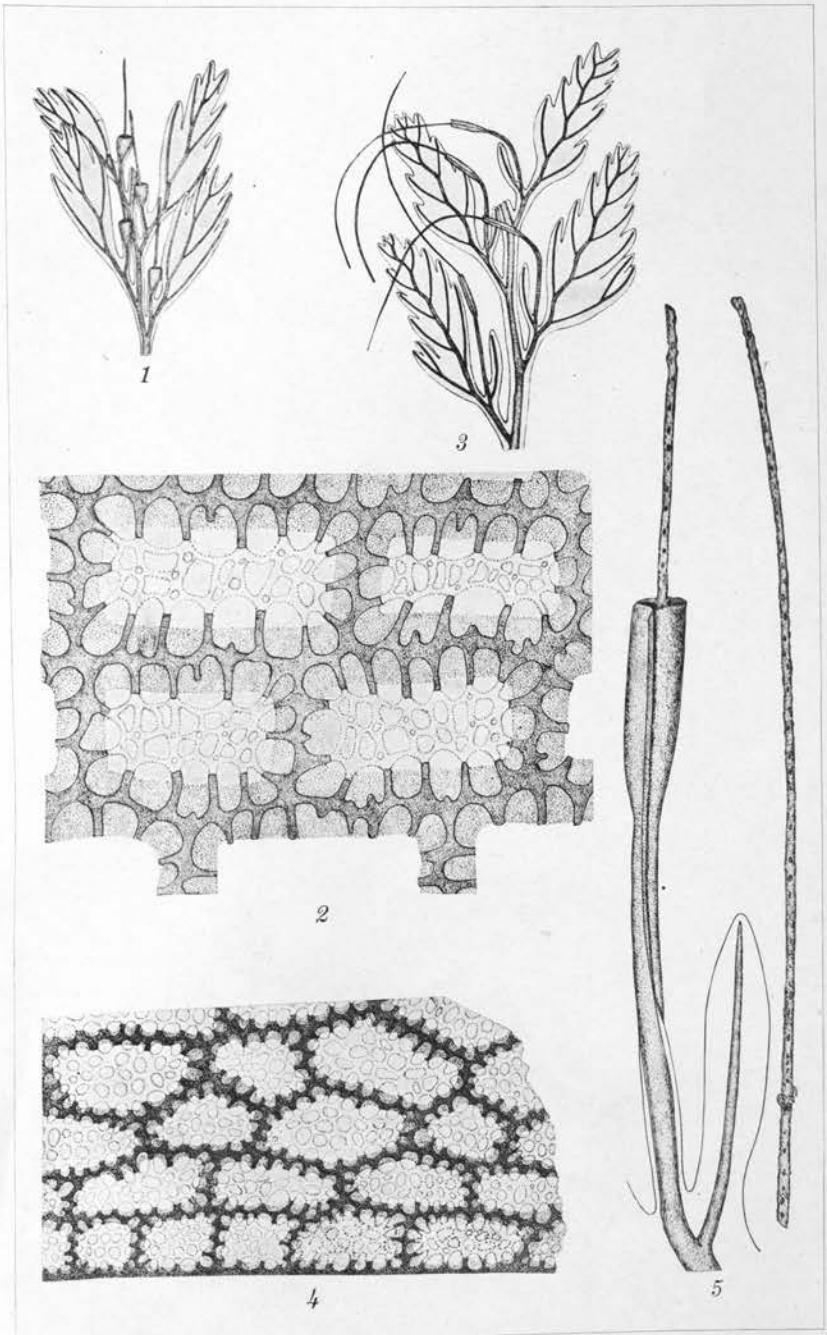

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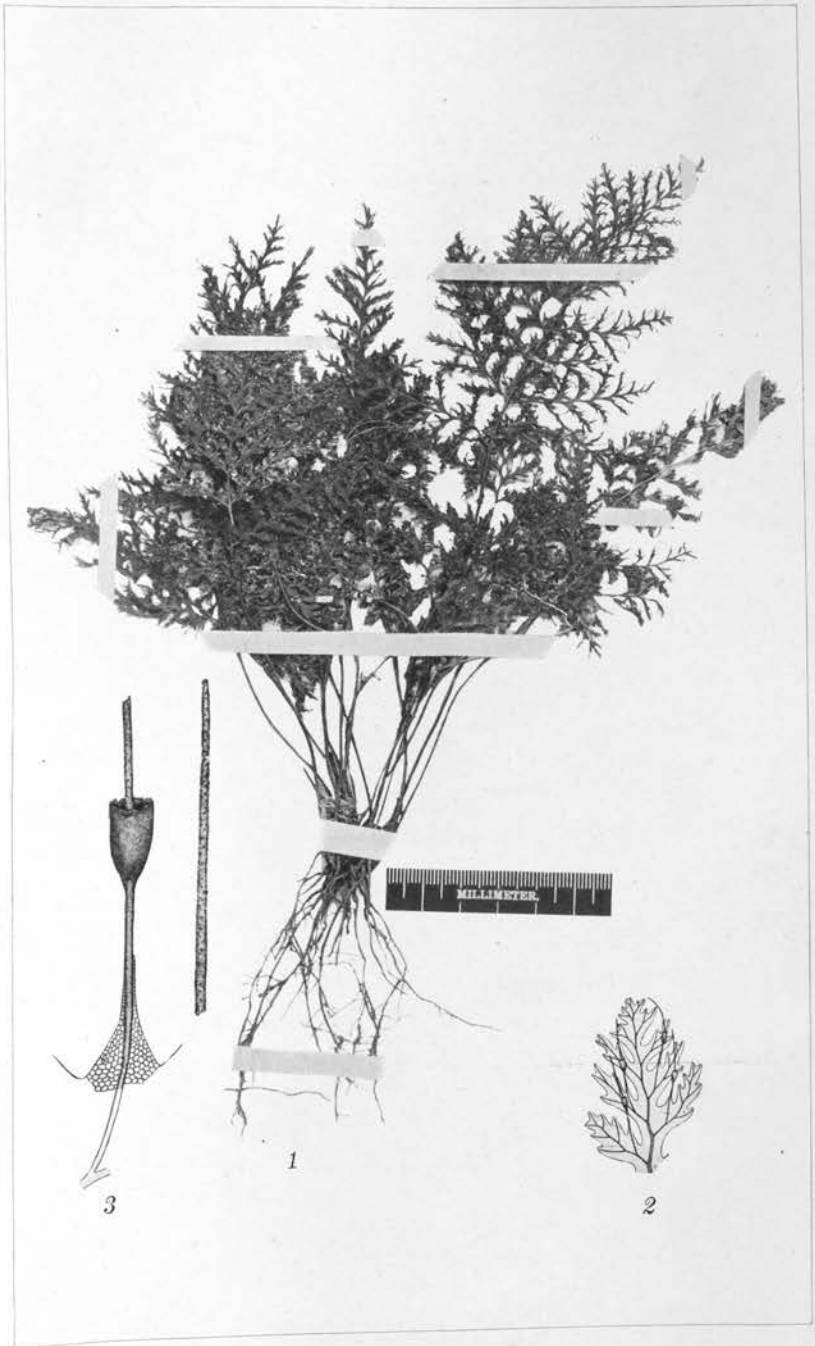

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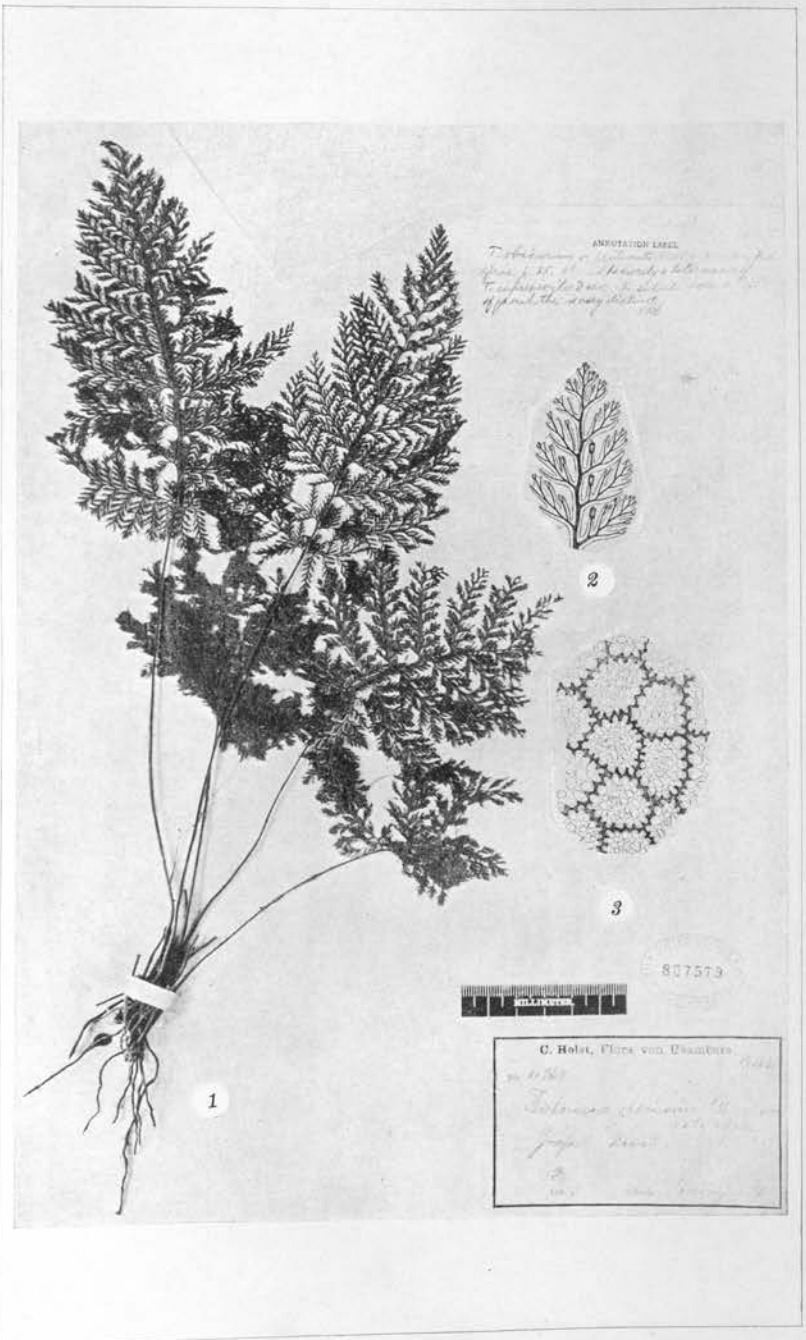

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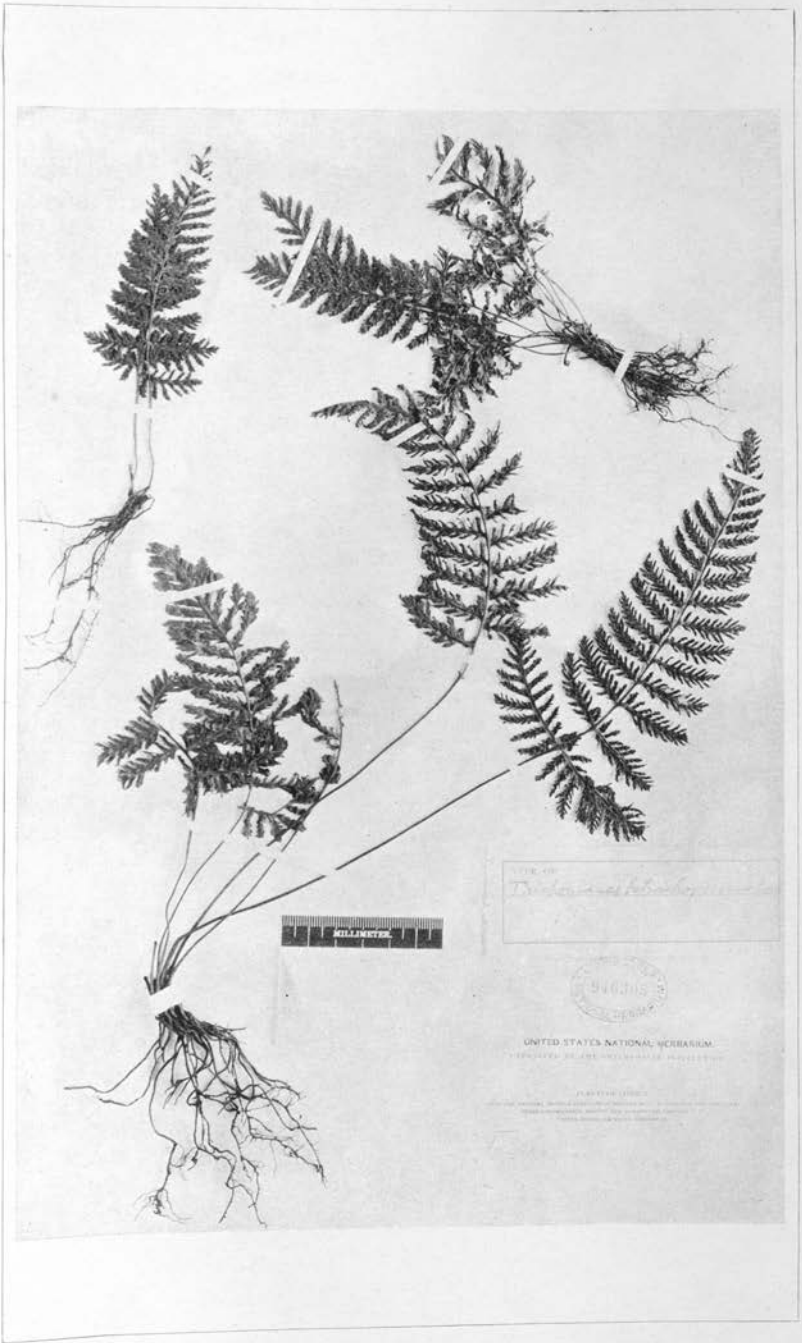

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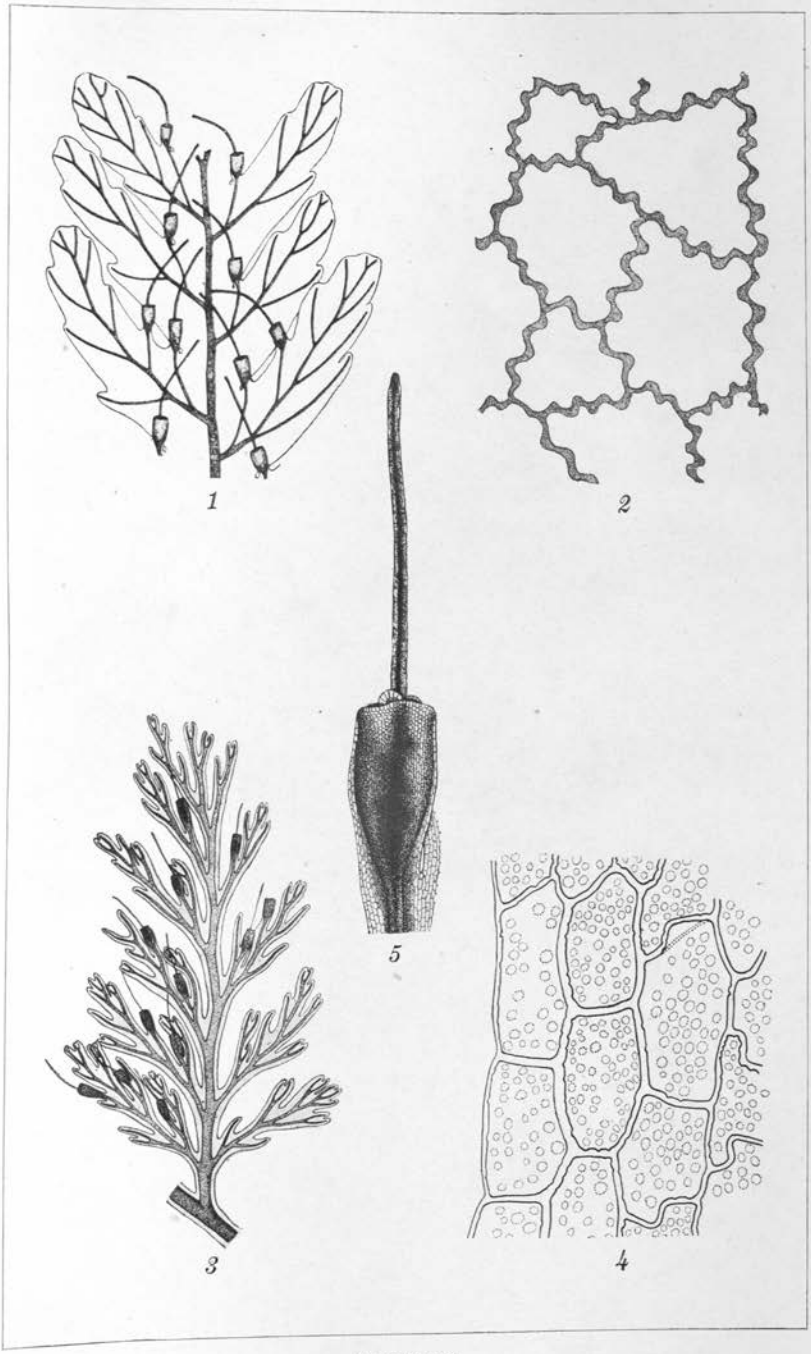

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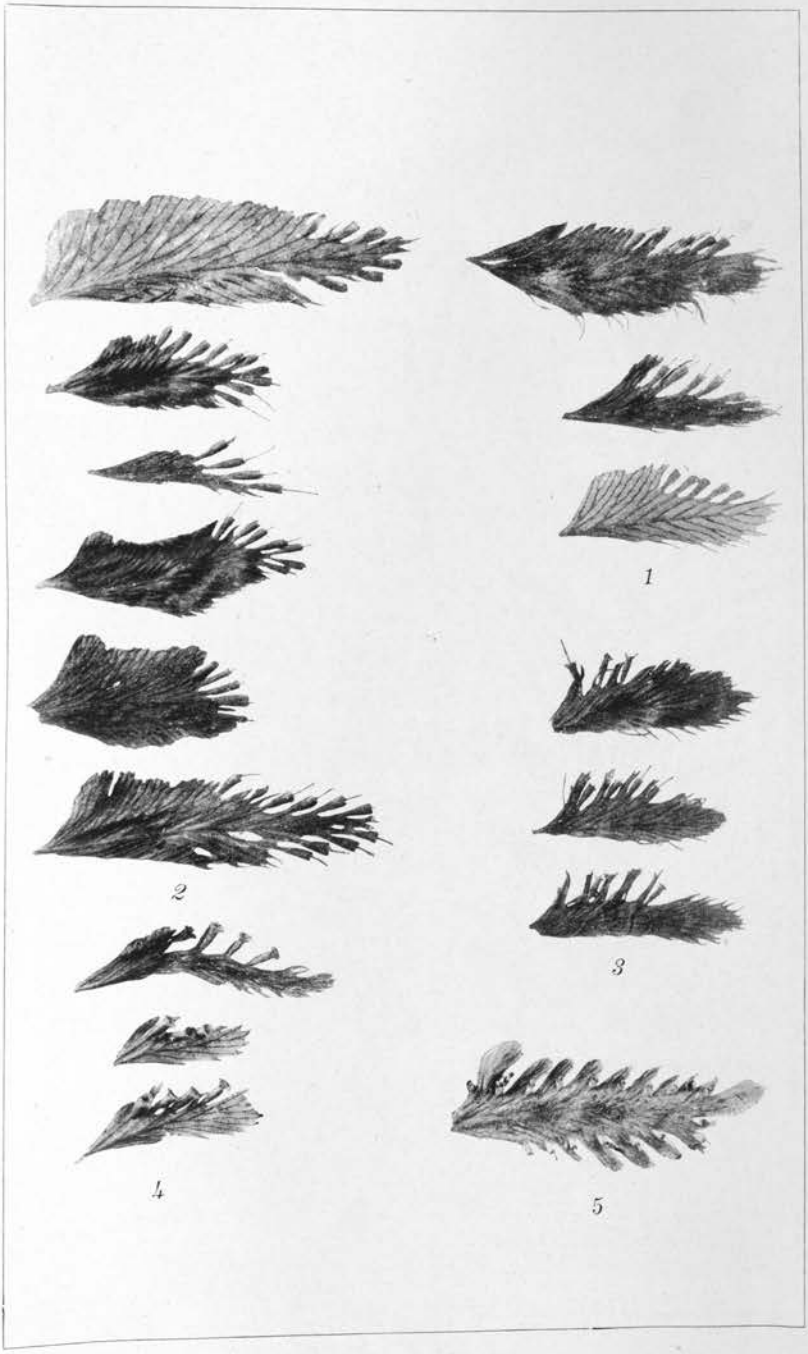

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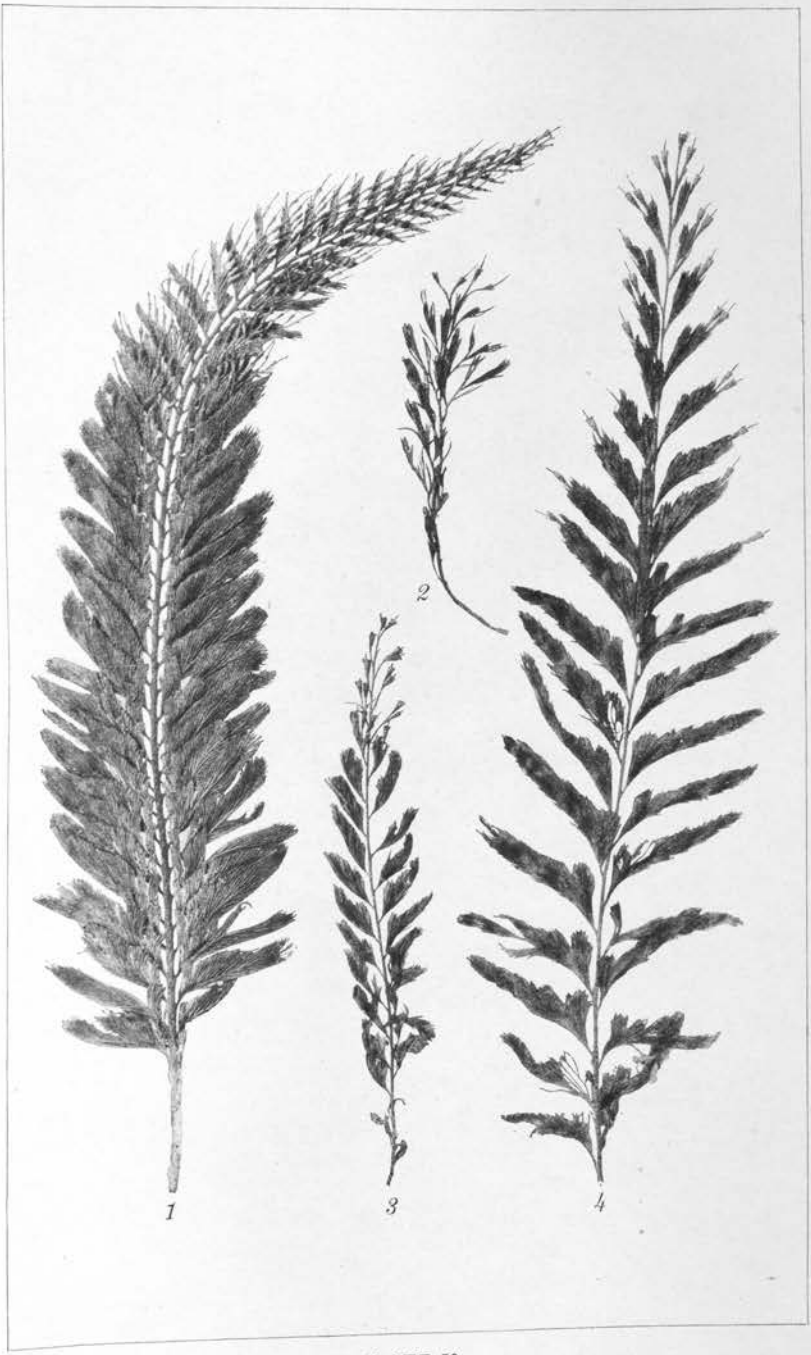
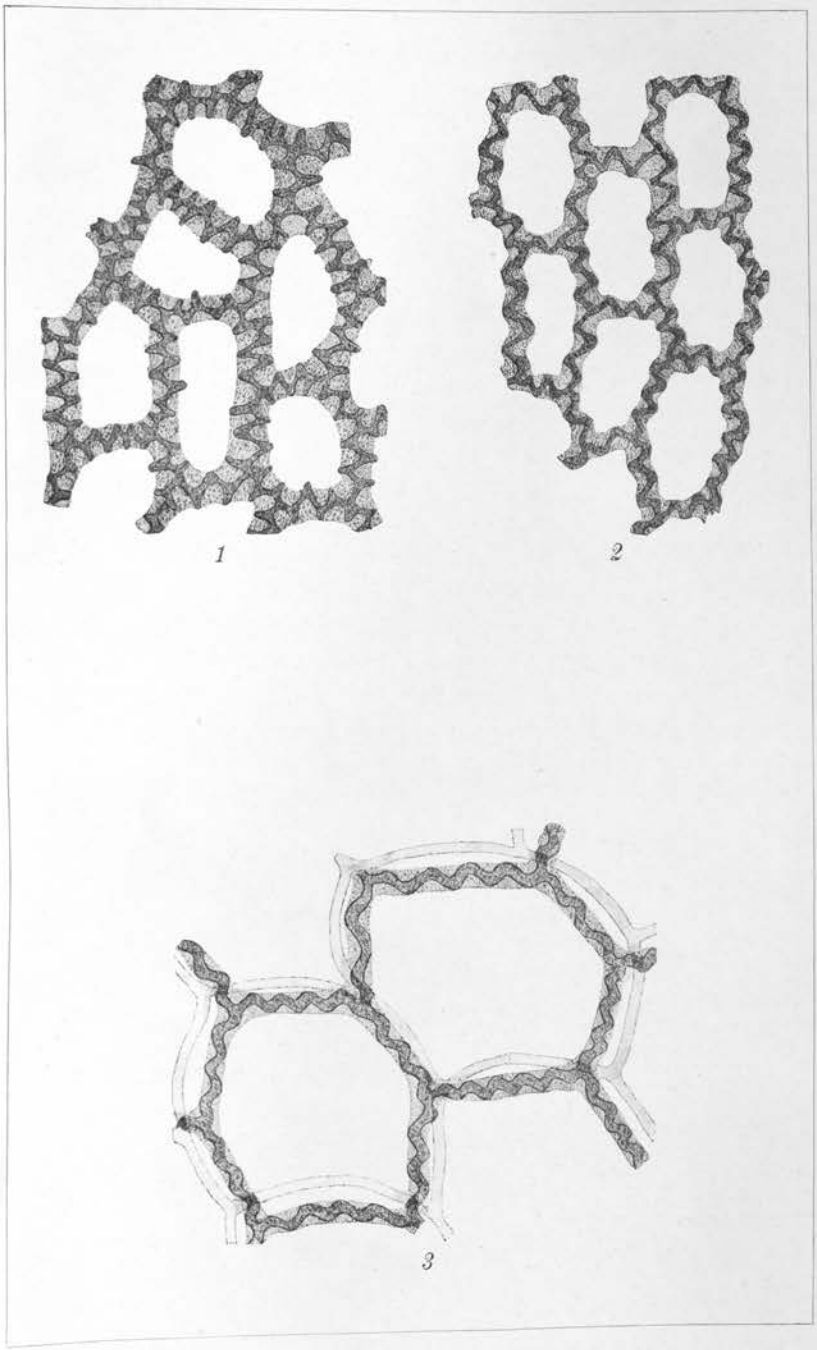


PLATE 53.


Trichomanes crassum Copel.
FLORA OF THE PHILIPPINES.
Trichomanes javanicum Bl.
CABALIAN
LEYTE
MAY 1922
G. LOPEZ

PLATE 54.



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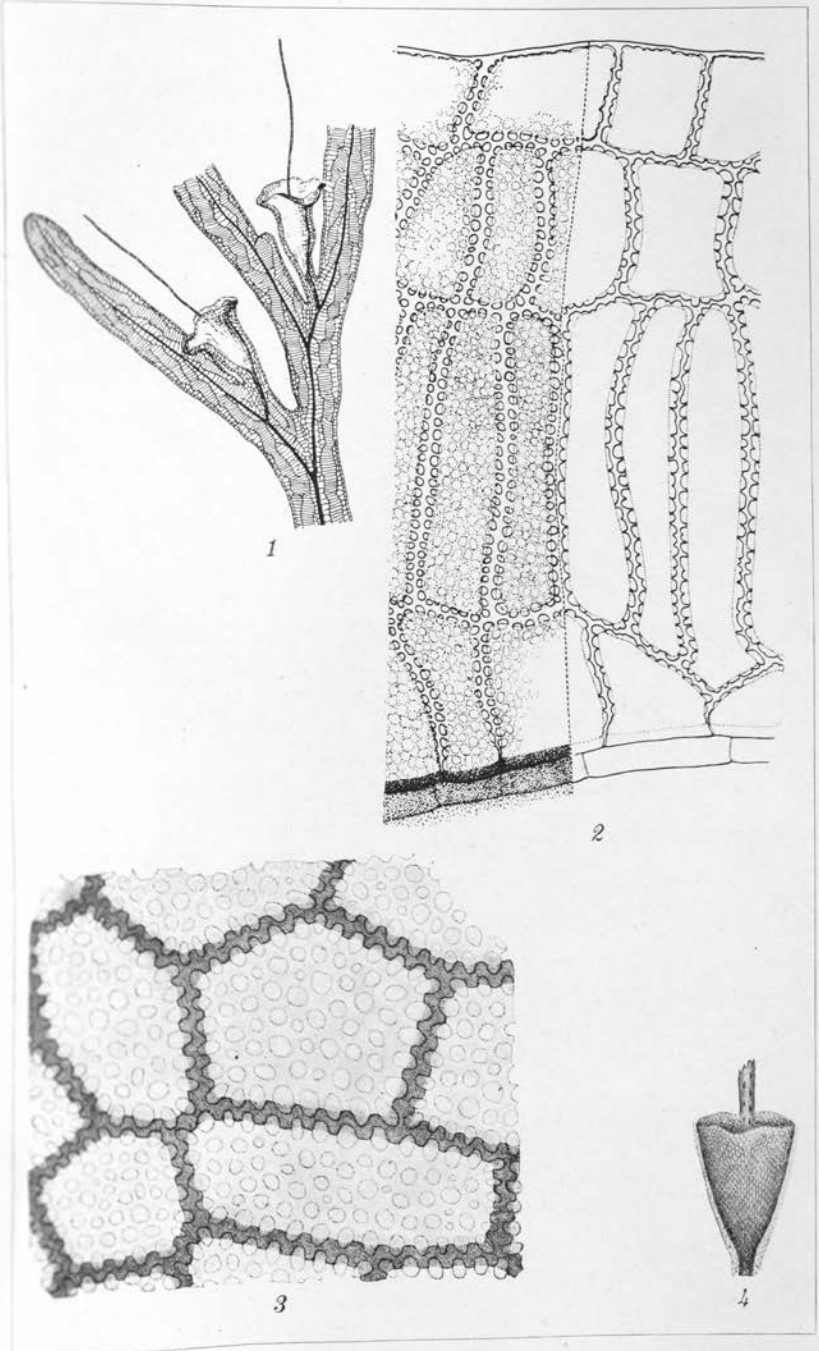

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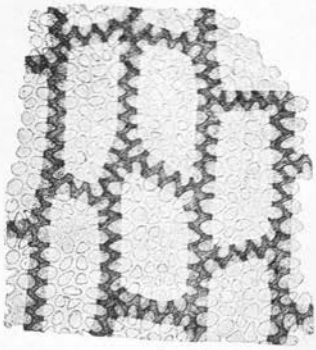

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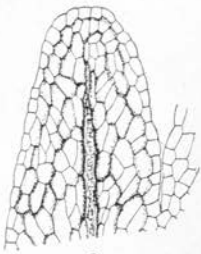

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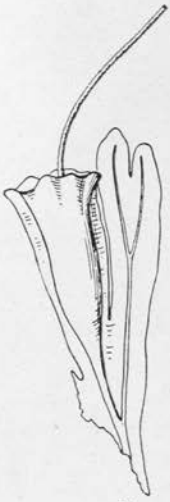

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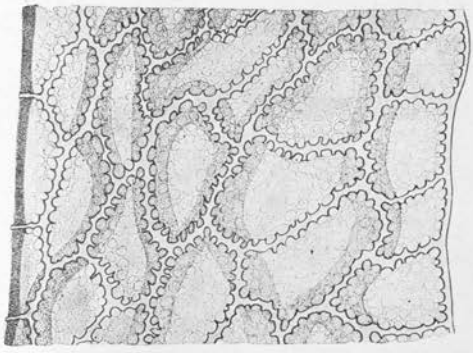

4

PLATE 57.

1 2

PLATE 58.

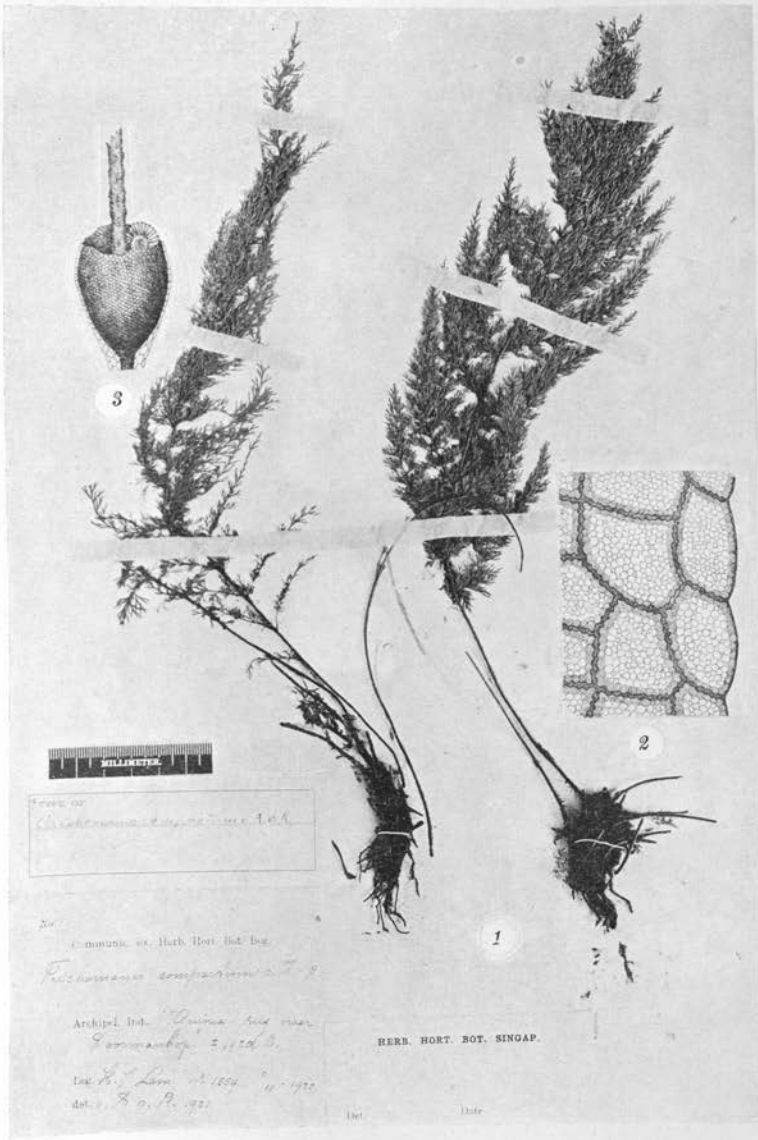

PLATE 59.

PLATE 60.

1 2

PLATE 61.